THE

ELECTRICAL REVIEW.

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"ELECTRICAL REVIEW."

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THE

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ELECTRICITY FOR MINES DRAINAGE.

IN our issue of October 16th it was stated that Col. Cochrane, chairman of the South Staffordshire Mines Drainage Commissioners, said that the use of electric pumps had commenced. We might have added that Mr. E. B. Marten, joint engineer, reported that the first electric pump installed gave such excellent results that three others had been put down at once. He says that these little pumps throw more water than any of the other stationary pumps. The advent of the Midland Electric Corporation, Ltd., made these economies possible, and we hope that both the supply company and the Mines Drainage will continue to benefit mutually. Wherever possible the company, which has its main generating station at Ocker Hill, near the centre of the Mines Drainage operations, and has sub-stations all over an area of more than 100 sq. miles, takes power to the pump-motors by means of overhead cables. It is pleasing to note that property owners have given the necessary permission for the passage of wires across their lands. It is only by such means that widely scattered motors, often far from the main roads, can be supplied with any hope of economy, and no undertaking was ever more in need of economy of any description than the Mines Drainage Commission. It is doing magnificent work in this heavily watered coalfield, but for one reason or another it has had to struggle with serious financial burdens for years. The Commission has compulsory powers to levy rates on every ton of coal gotten and raised, both on account of deep and surface drainage. These rates are adjusted from time to time. This year the outlook and the retrospect are particularly bad, because of the serious reduction of coal output; 3,000,000 tons were assessed for general drainage rates, there being a decrease of 85,000 tons. In only one district has there been an increase, and that the small one of 19,000 tons. On the other hand, the rainfall increased almost 3 in., making so much more water to be pumped. The actual quantity dealt with was over 18,000,000 tons, or 30½ tons per ton of mineral. The cost of pumping was ·17d. per ton of water, or 5·185d. per ton of coal. What with high railway rates, throttled canal systems, small pits, antiquated methods of working and idle miners, is it any wonder that the rich South Staffordshire coalfield cannot compete with others more favourably situated? There are many millions of tons of coal lying drowned and only waiting to be "forked," as the Cornish term goes, but there is little prospect of man's fingers touching much of it so long as the pumping authority is itself in need of "forking." The substitution of electricity for steam will, without doubt, reduce that 5d. per ton, and will result in more water being pumped than now from the same number of stations, but we can hardly hope that much new unwatering will be undertaken until the appalling load of debt has been raised. The chief advantages of the motor-driven

pumps over the steam pumps are, first, automatic operation which almost wipes out the wages charge; secondly, reduced maintenance charges; and thirdly, the low cost of energy. The pumps at present at work are in use on the surface only. Now that satisfactory water-tight motors are to be bought, we hope that the use of electricity will be extended to the pit.

THE PLEASURE OF BUSINESS.

In distributing the prizes to the successful students at the Halifax Municipal Technical School the other day, Mr. Bryce, M.P., made a speech on technical education, which follows the conventional lines of to-day. He pointed out that we require more scientific education, that to be really useful the teaching of applied science must be based on that of pure science, that science was king, and that that nation would have the most brilliant commercial and industrial future which was able most completely to master and apply the forces of nature in the most economical way. If we devoted more attention to education than in the past, and if the employers gave a good lead and all classes responded to it, we might still retain the place which England had hitherto held as the greatest industrial and commercial country in Europe. All this is very true, though not particularly new; and if the non-technical public in the United Kingdom could be brought really to believe in the pecuniary value of education in general, and our manufacturers to believe in the pecuniary value of specialised education, there would be more hope for us. But as long as it is considered more manly and valuable to the race for a young man to make a "century" on the cricket field than a discovery in the laboratory, this kind of preaching falls on wilfully deaf ears. Mr. Bryce, however, made two other remarks which are not so inevitable in political speeches on educational matters, for he remarked that one could not always be growing at the same rate, particularly if one had formerly been growing very fast. When a new disease is christened with a polysyllabic name by the physicians, all our friends have or die of it; and when a new nation enters into commercial competition it appears to grow at an astounding rate, because we base our conception of its growth on its percentage increase over the figures of last year, and ignore the absolute figures altogether. At the end of June, 1815, we occupied a relatively much more important position as a nation in Europe, in the world indeed, than we do now; but this is not to say that we have decreased in absolute importance since that time. Mr. Bryce's other point which has attracted us is where he said that a young man should not look upon his business merely as a means of making an income, although an income and a position in life are necessary for all of us. In other words, Mr. Bryce preaches the grandeur of work, not so much of "labour" as the word is commonly employed. It is a perfectly sound and judicious doctrine; but it applies to the man of science and the statesman rather than to the commercialist and tradesman of to-day. In the olden time, when a boot-maker made boots, choosing his leather, and selling his wares to a customer, he may be imagined to have felt a throb of pride every time that customer passed his door dryshod. But now nobody makes anything, only bits of things. Few makers sell their wares, they only distribute them among other distributors. It is difficult to see how any man can take pride in the process of retailing, his only pleasure apart from his profit must be the low one of "freezing out" a competitor. But the brain worker does make and sell his own goods, and though he is often scandalously underpaid, he finds his reward in the pleasure of creation. There are not so many professional men who would go on trying to invent useful things and striving to discover some of Nature's secrets, if the only guerdon they received were their fees and a problematical knighthood at the end of their career; they would prefer the less exhausting and more remunerative butcher's shop. We are often told that it is snobbishness for a professional man to exalt himself above his acquaintances who are in trade and commerce, and when he does it offensively or personally, such is admittedly the case. But since the highest characteristic of mankind is power to think, that class of work ranks first, and furthest removes its performer from the lower creation, which is done most with the brain and least with the muscles. Honourable men of commerce may lend dignity to the work they do: but the work he does, or tries to do, adds dignity to the man of science with the meanest personality. It is, indeed, a lucky thing for our country that such is the case; for did not research always find its reward in the mental gratification of work well done, not so many of our great men in the past would have been content to die in abject poverty or in the workhouse, and many of the wonderful discoveries of the Victorian era, which our fellow-citizens accept as a matter of course, would never have been made. At the same time this is no excuse for our employers and capitalists to pay unfairly low wages to their scientific experts, for the labourer is worthy of his hire.

A Few Words About Ourselves.

We wish to write very plainly upon a certain matter. We frequently have occasion to inquire of company secretaries, over the telephone, whether their meetings of shareholders are to be open to the Press. For our pains we sometimes receive an abrupt response: "Come if you like; but we're not going to pay!" The telephone as a medium for conversation does not permit us to act in the manner which our first impulse would dictate as the most deserving; and perhaps it is as well, for electrical firms may justly feel indignant at the prevailing attitude of the financial Press, which demands so many guineas per column for giving publicity to the proceedings, and if the golden guineas are not forthcoming, will either leave the meeting severely alone, or give a dozen hashed-up lines which are of little use to anybody. But what we object to is that we should be classed with the financial Press in the belief that their ways are our ways. Our contemporaries will do as they please. Soothing syrup for settling qualms of conscience is plentiful and cheap, and they doubtless find it easy to excuse their present system by saying that such a report is an excellent advertisement for which full payment should be made. We have no hesitation in describing it as a corrupt practice, and one which is bound to have as one of its leading consequences the misleading of the public. Many financial contemporaries seem to have little regard for the interests of the reader; it is only part of the game that a bucket-shop should be "exposed" in dramatic fashion now and then in order to preserve one's "reputation."

A few weeks ago at an adjourned city meeting a shareholder inquired why it was that a proper account of the last meeting was not put, through the medium of the Press, before the numerous shareholders who could not personally attend. The chairman replied that they were in financial difficulties, and could not afford to pay the six guineas per column which the Press demanded. The remark caused little surprise, because the meeting seemed to be largely composed of financial men, who know how these things are done in the City. We merely quote this as one instance of what is going on. Only this week we made application respecting the meeting of an electrical firm, and were informed that many Press representatives had made generous offers, but the company would not pay anybody. Is it surprising to observe that not a single Press representative besides that of the Electrical Review

was in attendance until toward the end of the proceedings, when he was joined by a solitary Press Agency reporter? An account of the meeting would presumably have been interesting matter *if paid for*, but *no pay, no report!*

We have made these remarks partly in order to very plainly state that the position of the Electrical Review is, and has always been, this: no payment of any kind has ever been accepted by us (and it has been offered a hundred times) for any matter published in our editorial pages, whether relating to City companies and their meetings, trade news or anything else. The insertion of matter must always rest at our discretion; we are the sole arbiters respecting what is and what is not interesting to the reader, and what is best calculated to promote the good of the electrical industry.

No doubt some will say that we are making a display of Pharisaical phylacteries; for that suggestion we care nothing. Our objection is that we are unwarrantably associated in some minds with the reprehensible practices to which we have referred. If company secretaries and officials—and, indeed, all of our readers—will please note this, we may be spared the treatment which, under a misapprehension, is sometimes meted out to us.

The Extraction of Radium.

Radium is at present by far the most expensive of all known metals, and it becomes a matter of great interest to know how it is produced. Hitherto, it appears to have been wholly obtained from "pitchblende," a native ore of uranium. Besides uranium, this ore contains many impurities, of which radium is one. The radium is found in such small quantities that it has been said that there is more gold in sea water than radium in pitchblende. Pitchblende is found in Bohemia, Cornwall, and several other localities; specimens from Colorado, U.S.A., have recently been examined by Prof. Curie, and declared to show excellent radio-activity. It is stated that a company is being organised at Denver, Colorado, for the purpose of extracting radium from the uranium ore found in that locality. The process for extracting radium from pitchblende is described as follows in the *Lancet*:—Operations for the extraction are commenced by crushing the pitchblende, and then roasting the powder with carbonate of soda. After washing, the residue is treated with dilute sulphuric acid; then the sulphates are converted into carbonates by boiling with strong carbonate of soda. The residue contains radium sulphate, which is an exceedingly insoluble salt. The soluble sulphates are washed out, and the residue or insoluble portion is easily acted upon by hydrochloric acid, which takes out, among other things, polonium and actinium. Radium sulphate remains unattacked, associated with some barium sulphate. The sulphates are then converted into carbonates by treatment with a boiling strong solution of carbonate of soda. The carbonates of barium and radium are next dissolved in hydrochloric acid and precipitated again as sulphates by means of sulphuric acid. The sulphates are further purified and ultimately converted into chlorides, until about 15 lbs. of barium and radium chloride are obtained by acting upon 1 ton of crushed pitchblende. Only a small fraction of this mixed chloride is pure radium chloride, which is finally separated from barium chloride by crystallisation, the crystals from the most radio-active of the solutions being selected. In this way the crystals ultimately obtained are pure radium chloride of a very high degree of radio-activity.

Specimens of radium prepared by Curie are 7,000 times more radio-active than uranium; the German specimens examined by Curie have not exceeded a radio-activity of 300.

MOTOR-GENERATORS AND ROTARY CONVERTERS.

By H. M. HOBART.

(*Concluded from page* 609.)

Note.—Two most unfortunate errors occurred in our last instalment of Mr. Hobart's article: fig. 4 was reprinted in place of fig. 8, and figs. 17A and 17B were accidentally interchanged.—Eds.

The Effect of Operating the Rotary Converter with Shunt Excitation alone.

We shall next investigate the action of this rotary converter when shunt excited, and with 9,000 ampere-turns, at full load—this giving unity power factor at full load and 980 amperes input per phase.

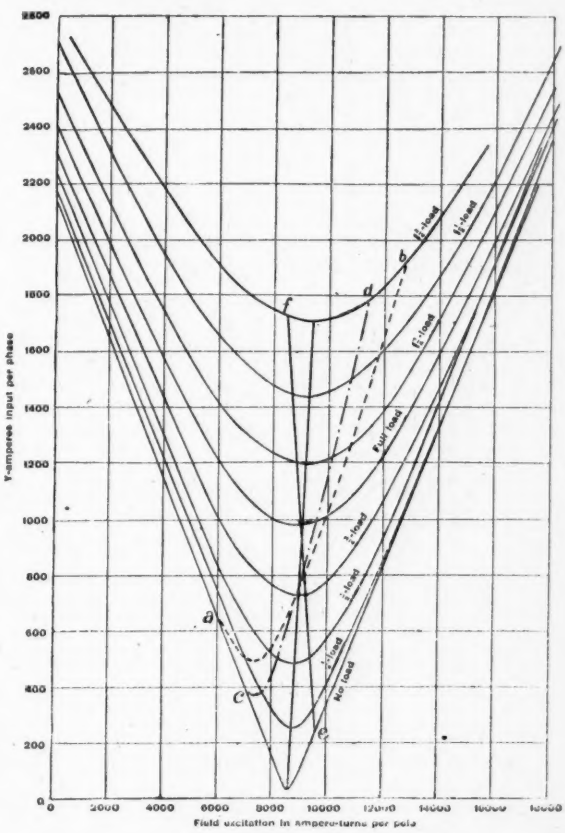


Fig. 8.

The straight line *e f* drawn in fig. 8 through the points

9,500 — 210

and 9,000 — 980

gives, by its points of intersection with the characteristic curves at various loads, the values given in Table X.

Table X.—Rotary Converter with Shunt Excitation.

i e, with 0 % compounding, and adjusted for unity power factor at full load.

Per cent. of full load amperes output from commutator.	Commercial efficiency of rotary converter.	Y-amperes input to rotary converter per phase.	Energy component of amperes input.	Wattless component of amperes input.	Power factor.	Field excitation (ampere-turns per spool).
0	0 %	210	25	208	·119	9,500
25 %	88·0 %	320	255	193	·797	9,400
50 %	94·3 %	503	485	140	·965	9,250
75 %	95·5 %	725	720	70	·994	9,150
100 %	96·0 %	980	980	0	1·000	9,000
125 %	95·5 %	1,195	1,190	80	·996	8,800
150 %	94·8 %	1,448	1,440	142	·995	8,600
175 %	93·5 %	1,710	1,700	200	·994	8,400
200 %	92·0 %	1,995	1,980	245	·993	8,200

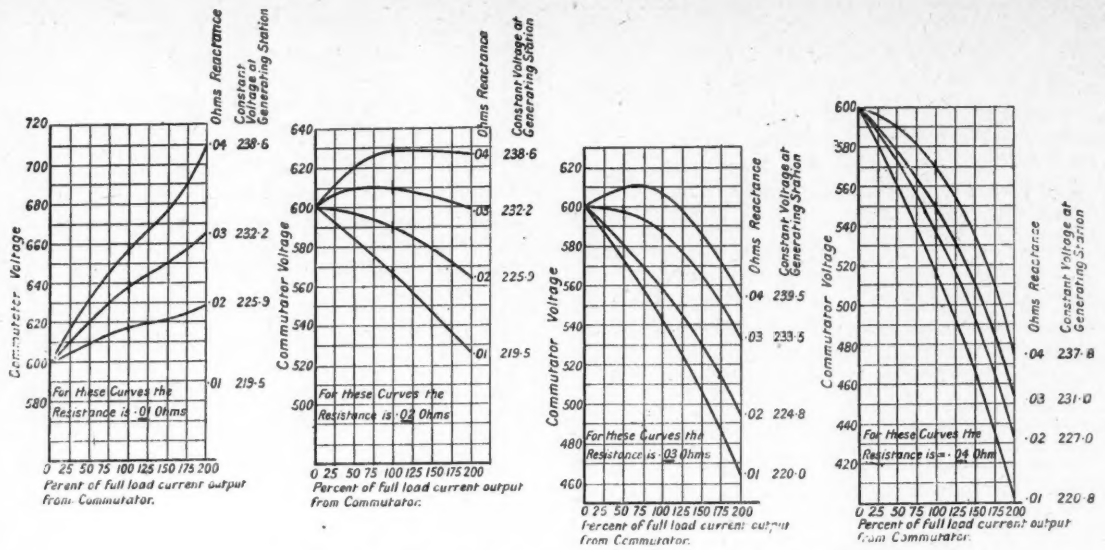


Fig 17A.—64 Per Cent. Compounding. Full Load Excitation, 6,000 shunt ampere-turns per pole, 3,830 series ampere-turns per pole.

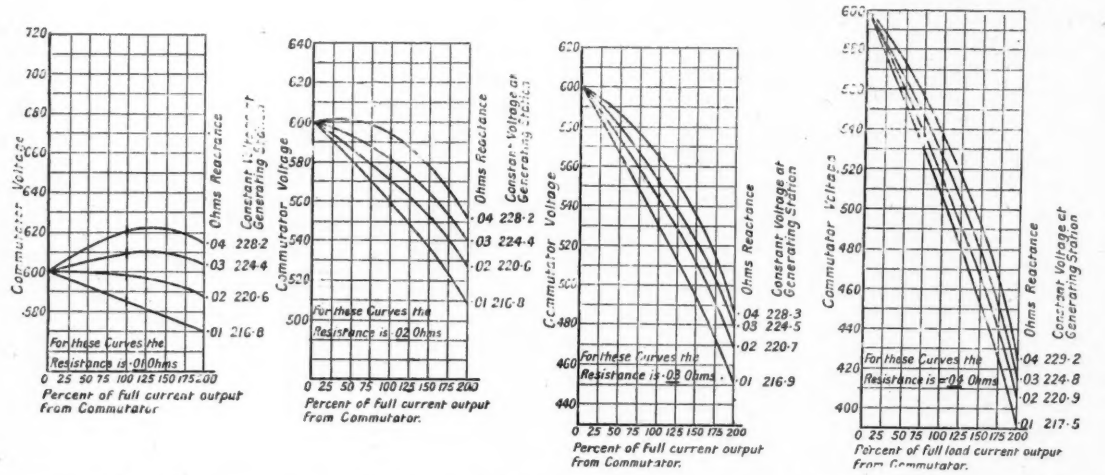


Fig 17B.—36 Per Cent. Compounding. Full Load Excitation, 7,000 shunt ampere-turns per pole, 2,530 series ampere-turns per pole.

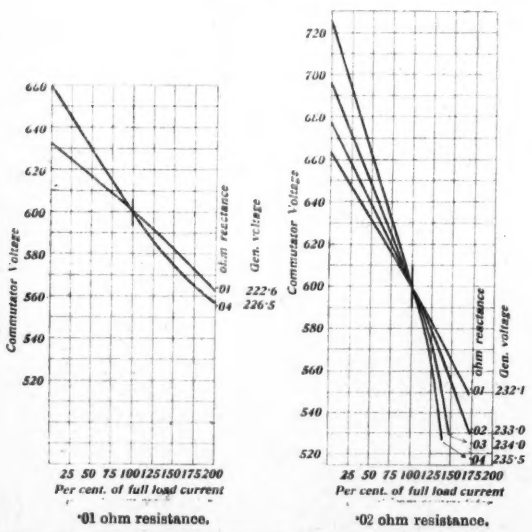


Fig. 17C.—Shunt Excitation Only. Unity Power Factor at Full Load.

The results in Table X. are plotted in the curves in fig. 16 (p. 561), from which it is seen that for the rotary converter with shunt excitation there is practically no wattless component available for magnetisation and demagnetisation in regulation.

For a resistance of 0·01 ohm and a reactance of 0·01 ohm per phase, and with 222·6 volts at the generator, the regulation is as follows :—

No load	... ...	Commutator voltage	= 632
Full load	... ...	" "	= 600
2 × full load	... ...	" "	= 562

For a resistance of 0·01 ohm and a reactance of 0·04 ohm per phase and a generator voltage = 222·6 :—

No load	... ...	Commutator voltage	= 660
Full load	... ...	" "	= 600
2 × full load	... ...	" "	= 557

For a resistance of 0·02 ohm per phase, the values set forth in Table XI. were obtained.

Table XI.—Shunt Excitation.

Ohms reactance per phase ...	0·01	0·02	0·03	0·04
Generator voltage	232	233	234	235·5
	Commutator voltage.			
No load	663	678	696	725
Full load	600	600	600	600
1·25 × full load	—	—	—	565
1·5 × full load	—	—	521	—
1·75 × full load	546	527	—	—

The values in Table XI. are plotted in the curves of fig. 17C.

The curves in fig. 17D summarise the results for "64 per cent. compounding," "36 per cent. compounding," and for shunt excitation (*i.e., no compounding*).

Taking the diagrams of fig. 17 in *vertical* rows, those at the left correspond to low line resistance; and the further one goes towards the right, the greater is the line resistance. The curves of the upper left-hand diagram, where the line resistance is low and the compounding high, are in striking contrast to those lower down and towards the right, where the line resistance is greater and the compounding lower.

The results of this investigation, as brought together in the groups of curves of fig. 17, afford ample evidence that only in cases where the distance of transmission is so short, the voltage so high, or the outlay for cables so great that a very low resistance per phase is obtained, can rotary converters be satisfactorily operated for automatic control of the commutator voltage for practically constant voltage at all loads, much less then for 5 per cent. or 10 per cent. higher commutator voltage at full load than at no load. Even with a low resistance per phase, it is necessary to provide large, expensive and wasteful auxiliary reactance coils in order to obtain satisfactory voltage control by automatic phase adjustment, and for anything more than a very low resistance per phase, there is soon reached a value of the reactance beyond which it is ineffective in producing improved conditions in this respect. In fact, with shunt excited rotary converters, as may be seen from the curves in the third row of fig. 17, and even with a small percentage of series winding, reactance makes the regulation still worse. The curves also show the great importance of a large percentage of series winding from the standpoint of regulation of the commutator voltage by phase control.

It must further be remembered that these estimations have been made upon a rotary converter of very liberal design. From any other standpoint than that of regulation, a much cheaper design would have been permissible, but would, so far as relates to this feature of voltage control, have led to decidedly worse results. In consequence of the absence of armature reaction in rotary converters operated at unity power factor, such a machine should, in the interests of an economical design, be proportioned with a strong armature and with a magnetic circuit of small cross-section; the saturation should also be high, as also the "nominal" current density in the armature conductors, because of the partial mutual neutralisation of the alternating current by the continuous current components of the total current. All these features have, however, to be partly sacrificed in the interests of phase control. Then, again, the weaker the series winding, the higher is the average power factor of a rotary converter operated in this manner. This may be seen by comparing the curves of figs. 9, 15 and 16 (pp. 650—651). Thus, again, we see that good automatic commutator voltage regulation by phase control, requires a poor power factor at all except a very narrow range of loads.

Practical Application of these Principles.

It should be of interest to apply these principles to a typical case, and as very complete data has been published* on the Central London Railway, this installation may be chosen for our purpose.

Owing to the short distance of 6¼ miles from the power house to the most remote sub-station, the conditions are especially favourable to a fair showing for rotary converters. The original sub-station installation consisted mainly of six 900-kw. rotary converters, twenty-one 300-kw. air blast transformers, with blower sets for circulating the air through them, and all necessary switchgear and auxiliary apparatus. These were located in three sub-stations, distant respectively, 1·6, 3·5, and 6·2 miles from the generating station. The average distance is, therefore, about 3·8 miles. The high-tension cable equipment for the whole plant comprised:—34,000 ft. of lead-sheathed, paper insulated, three-core cables of a cross-section of 0·1875 sq. in. of copper per core; and 74,000 ft. of lead-sheathed, paper insulated, three-core cable of a cross-section of 0·125 sq. in. of copper per core.

Taking the cost* of these two cables at £800 per mile, and £600 per mile respectively, the total cost is made up as follows:—

Cost for 0·1875 sq. in. cables $\frac{34000}{5280} \times 800$	...	£5,150
" " 0·125 " " $\frac{74000}{5280} \times 600$	...	8,400
		£13,550
33 per cent. for connections in power house and sub-stations†		£4,450
Total outlay for cables		£18,000

or £3 3 per kw. rated output of rotary converters installed.

Take the cost of the rotary converters at £2·5 per rated kilowatt, and of the air blast transformers and ventilating motors at £1 per rated kilowatt, and sub-station switchboards and gear at £1 per rated kilowatt of sub-station,

$6 \times 900 \times 2{\cdot}5$ ... £13,500 for six rotary converters.
$21 \times 300 \times 1{\cdot}0$ ... £6,300 for 21 air-blast transformers and ventilating motors.
$6 \times 900 \times 1{\cdot}0$ ... £5,400 for switchboards and gear.

While the above costs are made up from round figures, they are thoroughly representative of the market prices of that date. If one were to lay out a plant of similar capacity using motor-generators, two-thirds as great total copper cross-section in the cables would be ample, less sub-division of the cables would be necessary, and three independent cables from the power house would give fully as great security as the four cables employed in the rotary converter installation. Hence the individual cables would have but slightly less cross-sections of copper per core, and the specific cost would be but slightly increased. The cost for cables thus becomes: —$1{\cdot}03 \times {\cdot}67 \times 18{,}000 = £12{,}400$.

Taking the cost of motor-generator sets 75 per cent. higher than that of the rotary converters, gives

$1{\cdot}75 \times £13{,}500 = £23{,}600$ for motor-generators.

The transformer item falls out.

The outlay for switchboards and gear may be taken two-thirds as great per kilowatt, since the number of panels, switches, bus-bars, &c., may be greatly reduced and simplified.

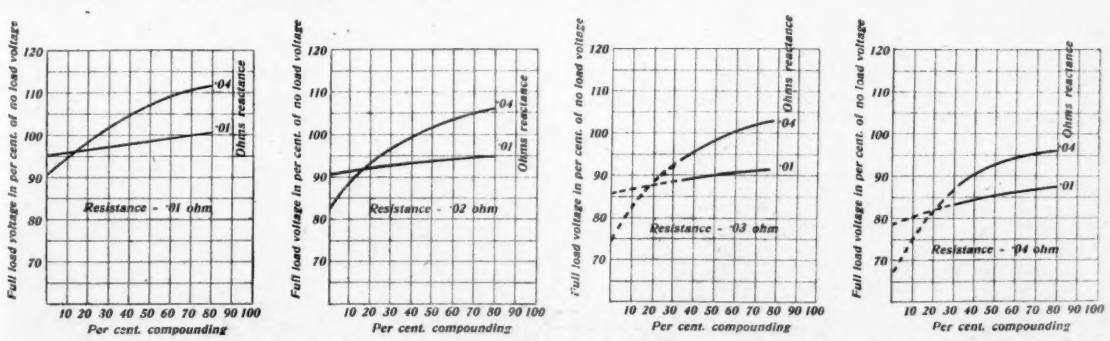

Full load voltage in per cent. of no load voltage
Per cent. compounding
Ohms reactance
Resistance - ·01 ohm
Resistance - ·02 ohm
Resistance - ·03 ohm
Resistance - ·04 ohm

Fig. 17D.—Summary of Results of Figs. 17A, 17B and 17C.

* See *Engineering*, February 18th, 25th, and March 4th, 1898; Electrical Review, June 1st, 8th, 15th, 22nd and 29th, 1900.

* Rough published data for cost of cables may be found in Appendix VIII. of Mr. O'Gorman's paper on the "Insulation of Cables" (*Proceedings I.E.E.*, Vol. XXX., 1901, p. 690); in Mr. Earle's paper on "The Supply of Electricity in Bulk" (*Proceedings I.E.E.*, Vol. XXXI., 1902, p. 895); and in Mr. Stewart's paper on "The Influence of Sub-station Equipment on Cost of Electricity Supply" (*Proceedings I.E.E.*, Vol. XXXI., 1902, p. 1122).

† This percentage is high in the case in question, because of the very short distance between sub-stations.

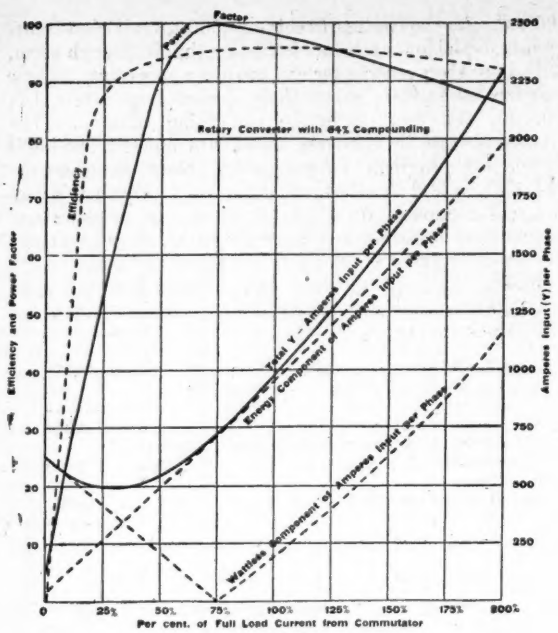

Efficiency and Power Factor
Amperes Input (Y) per Phase
Per cent. of Full Load Current from Commutator
Rotary Converter with 64% Compounding
Efficiency
Power Factor
Total Y – Amperes Input per Phase
Energy Component of Amperes Input per Phase
Wattless Component of Amperes Input per Phase

FIG. 9.

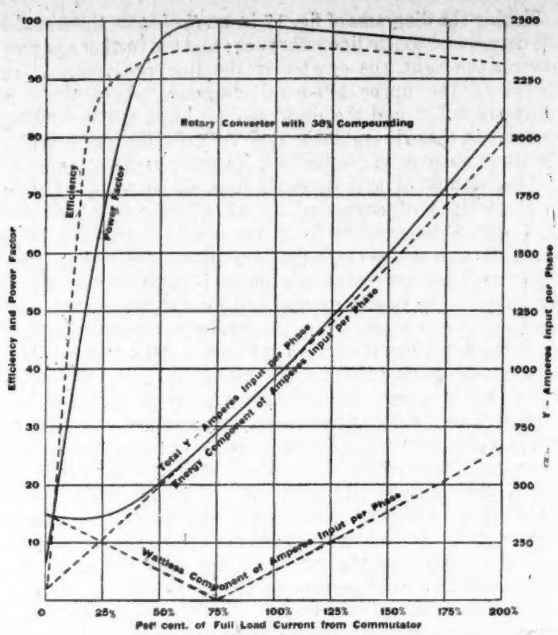

Efficiency and Power Factor
Y – Amperes Input per Phase
Per cent. of Full Load Current from Commutator
Rotary Converter with 36% Compounding
Efficiency
Power Factor
Total Y – Amperes Input per Phase
Energy Component of Amperes Input per Phase
Wattless Component of Amperes Input per Phase

FIG. 15.

Outlay for switchboards and gear = 0·67 × £5,400
= £3,600.

TABLE OF COMPARATIVE COSTS.

High-tension cables	£18,000	£12,400
Rotary converters	13,500	—
Motor-generators	—	23,600
Step-down transformers and ventilating sets	6,300	—
Sub-station switchboards and gear	5,400	3,600
	£43,200	£39,600

Whether the interest on this 9 per cent. less outlay for the motor-generator scheme would affect the 3 per cent. to 6 per cent. lower efficiency of operation, would require a careful analysis of the operating costs.

Moreover, it is highly probable that a still less proportional initial outlay for cables would be permissible with motor-generators, if the interest on the saving justified the decreased economy in operation. The cross-section of cables, so far as reliability in service is concerned, would be determined from the point of view of the permissible current density, or rather the permissible heating, and not from that of the permissible CR drop.

It is by no means intended here to assert that in the Central London plant the use of motor-generators would have led to ultimate higher earning capacity; but so much data has been given to the public on this particular plant as to permit of a fair comparison on the basis of published data. It serves to illustrate the basis on which a comparison should be made, and shows that with longer systems requiring a greater proportional outlay for high-tension cables, the balance tends towards showing an economic advantage to be gained by the use of motor-generators.

WASTE OF ENERGY IN TENDERING.

By E. K. SCOTT, M.I.E.E., A.M.I.C.E.

A DISTRESSING feature of the present system of tendering for electrical work is the very large amount of wasted brain energy which it necessitates. Competition has become so keen that it is quite common for a hundred or so tenders to be sent in for quite a small contract, such, for example, as an extension steam dynamo for a central station. The preparation of these tenders represents a great deal of time wasted by those who are engaged in the estimating and drawing offices of various firms, and the writer contends that the bulk of such time is a direct loss to the profession. Of course, a certain amount of competitive tendering is necessary; but when it comes to 50 firms submitting over 200 separate prices for a contract which, after all, may only amount to about £1,000, the matter has reached a stage which borders on the absurd. This is especially so when one considers that a large number of the prices are cross tenders. That is to say, an engine firm will submit prices of their engine with about a dozen different makes of dynamos, and, on the other hand, the dynamo maker submits prices for his dynamo coupled to a dozen different types of engines. It not only wastes the time of those who have to make up such tenders, but it is also confusing to the engineer who has to analyse them.

When there is much cross tendering, information is liable to leak out before the time, and possibly this is why many firms make a practice of telegraphing their prices at the last minute. The delay and expense entailed by this kind of thing is quite a serious matter, especially if it happens that several separate tenders have to be sent off on the same day.

Municipal contracts must, of course, be publicly advertised for, and a company is in a much better position in this respect, because the engineer can select a few firms from whom to ask prices, and by not having a committee of shop-keeping councillors to please, he decides the matter with a minimum of trouble. Possibly this is one reason why a company's station is, as a rule, more uniform than a municipal station, and it should be remembered that such uniformity of plant means a good deal in decreased attendance.

Probably the worst case of wasted brain energy occurs when somebody decides to ask for prices for completely equipping his works, mine or quarry, &c., with electric power. Instead of calling in an expert to advise and draw up suitable specifications, he writes to various manufacturing firms, and generally manages to convey very little really useful information. More often than not he is one of those ducks who talk of *nominal* horse-power and whose idea of high pressure steam is 40 lbs. to the square inch.

Anyway, the information is so vague that the various firms find it necessary to send down a representative, and in so many words, they each act as consultant to the job, and in due course submit detailed specifications, drawings and prices, which cost a good deal of money to get out. The inquirer, finding he is a little beyond his depth, pigeon-holes the papers, and if the matter does crop up again years afterwards, the conditions are literally so different that the whole thing has to be gone into *de novo*.

This sort of thing occurs every day, and it takes a particularly aggravated form when the inquiry is from the Colonies or abroad, as it then resolves itself into a series of lessons on electrical engineering by correspondence. Occasionally the inquirer decides to order some plant, and he forthwith places the matter in the hands of a shipping firm in the City, whose regular business may be the buying and

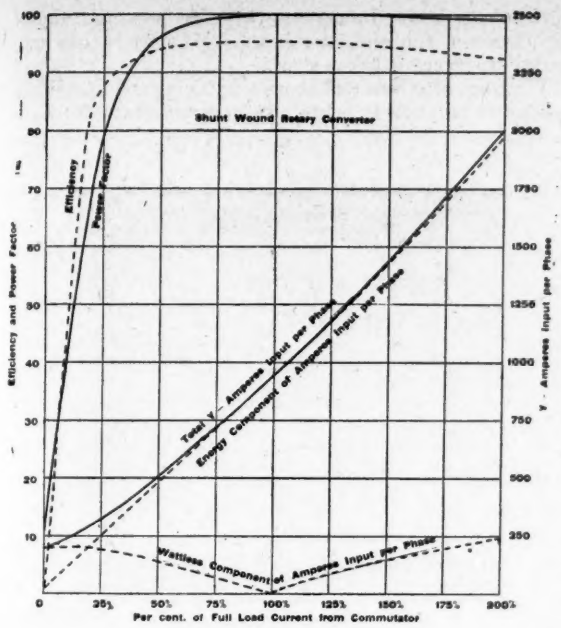

Shunt Wound Rotary Converter
Efficiency
Phase Factor
Total V - Amperes Input per Phase
Energy Component of Amperes Input per Phase
Wattless Component of Amperes Input per Phase
Efficiency and Power Factor
V - Amperes Input per Phase
Per cent. of Full Load Current from Commutator

FIG. 16.

selling of jute, sugar, dry goods, or other commodity equally remote from machinery. Such firm has usually a clerk, one of whose relations is a timekeeper in a foundry (mechanical), or possibly a platelayer (civil engineer), and so being himself an engineer by *instinct* as it were, he is given the job of sending out inquiries and adjudicating on the tenders. Needless to say, the lowest price gets it every time, irrespective of what is offered, and after Mr. Clerk has done this a few times he applies for admittance to the Institution; in the bad old days he used to get in, too, his proposers and supporters being members of the firms who received the orders.

The killing off of a few of the smaller concerns, and the combining of the larger ones, is apparently the tendency of the times, and if it does nothing else, it may at any rate minimise the present appalling waste of brain energy in the manufacturing and contracting branches. The writer heard of a firm the other day which tendered for every job advertised, whether municipal or otherwise; in 12 months they were only successful on two occasions, and in one of these there had been a slip in the price, so the tender had to be withdrawn. But what are we to say of the brain energy which all that useless tendering represented; is it not a distinct loss to the profession?

THE CONTINENTAL ELECTRICAL ENGINEERING INDUSTRY.

Losses on Large German Machines for Years.—The Teutonic Hold on Austria.

The electrical engineering works in Germany are fully employed at the present time, but there is no cessation in the complaints respecting unsatisfactory prices. In fact, it is only necessary to consider the wide divergence between the tenders submitted for public contracts in order to understand the eagerness manifested to obtain orders at any price whatever, with a view to keeping the works in full operation. The cable syndicate has been dissolved, and free competition is so much the rule that one of the largest electrical firms, on the publication of the list of tenders sent in for a contract at Posen, is said to have actually offered to undertake the work at 7 per cent. less than the lowest tender, and at 12½ per cent. less than its original quotation. All reports of a recovery in the electrical engineering industry are incorrect, and it is important to note the statement made in interested circles that *money has been lost for years on large machines.* This fact explains the reason for the low prices at which orders have been accepted in England and other countries in recent years. It is now expected, as, indeed, it has been for several months past, that the mining and iron and steel trades will come forward with large orders as a result of the reserve manifested in this direction by these branches for some time past. This anticipation may possibly be realised, as the coal and metallurgical companies have on the whole yielded more satisfactory results during the financial year ended with June. The formation of an incandescent lamp syndicate of German, Austrian and Dutch makers has already had the effect of improving prices.

German Companies.

The Rheydt Cable Works Co., of Rheydt, which has a working capital of £62,500 out of a nominal capital of £75,000, has been successful in improving its position during 1902-03. In fact, the report of the directors frankly states that the expectations entertained at the beginning of the year have been exceeded, and the orders on hand are also anticipated to provide profitable employment in the present year. The gross profits amount to £17,281, as compared with £13,940 in the previous year, and after providing for depreciation and reserve funds, a dividend at the rate of 12 per cent. has been declared, as against 10 per cent. in 1901-02.

The recent meeting of shareholders of the German Cable Works Co., of Rummelsburg, near Berlin, approved the accounts submitted for the financial year 1902-03. After absorbing the reserve fund, the company closed the previous year's trading with a loss of £7,067, but it has now been possible to extinguish this deficit out of the gross profits of £12,292 earned during the past year. Having done this, and made provision for depreciation, the slight balance remaining has been placed to the credit of the guarantee account. It was stated at the general meeting that the course of business in the current year has been more satisfactory, and the turnover has so far been 60 per cent. in excess of that of the corresponding period of the preceding year.

Austrian, Swiss and Other Enterprises.

The position of affairs in Austria is very similar to that in Germany. The works are now well employed, but prices are from 15 per cent. to 20 per cent. less than they were a few years ago, and at times the offers of the large works are underbid to the extent of 50 per cent. Not only so, but the conditions of payment are less satisfactory as the final settlement of accounts now extends over a few years, and the result is that the large works have debts outstanding which amount to many thousands of pounds. The Austrian establishments complain severely of German competition, whilst at the same time the export capabilities are restricted, and the branches established by Teutonic works are also hampered in developing the external trade owing to the agreements existing with their German parents. The principal customers at present are the ironworks, and other industries, but the transformation of horse tramways, and the establishment of electric lighting stations, have practically ceased as the experience gained in these respects has been unsatisfactory as a consequence of such undertakings requiring to be financed as well as carried out by the contractors for the supply of the machinery.

Brown, Boveri & Co., of Baden, Switzerland, which has a paid-up capital of £500,000, has just issued a 4 per cent. loan to the extent of £200,000, of which £152,000 has been taken firm by a syndicate of Swiss banking institutions. The company is reported to have received an order from the recently-formed Société d'Electricité de Paris for the machinery equipment of the new generating station to be erected in the French capital. The order, which is the largest that has ever been booked by the company, is for the delivery of four large steam turbines and dynamos of a total of 30,000 H.P. The Paris Electrical Co. in question will have among its customers the Metropolitan Railway Co. and the tramways of the Parisienne Electrique, which belong to the same group as the founders of the first-mentioned company.

The position of the Franco-Swiss Co. for the Electrical Industry of Geneva is far from satisfactory, judging from the results of the past year's trading. It is true that the profits amount to £11,360, as compared with £19,750 in the preceding 12 months, but it has been found necessary to devote a considerable portion of the former sum to the purpose of depreciation of the newly-constructed and old works. Not only so, but the whole of the £50,000 standing in the amortisation fund is being absorbed for the same object. It is understood that the company has incurred a heavy loss in connection with the Italian Electro-chemical Co., the amount of which is put at approximately £32,000. A reference to the latter company will be found below.

The Russian Union Electricity Co. of St. Petersburg, which owns, next to the branch works of the Siemens & Halske Co., the largest manufacturing undertaking of its kind in that country, has been financially unsuccessful since its formation nearly four years ago. It was constituted with a share capital of £600,000, and the accounts for the past year reveal a total deficit of £227,000, or more than one-third of the capital. This loss apparently extends over two or three years, and is due, among other things, to the realisation of securities, depreciation of materials and losses on guarantee transactions and schemes which have not been carried into effect. The company maintains branches at Kieff, Warsaw, Odessa and other towns, and is also interested in various electrical companies. It is proposed to reorganise the company with the special object of liberating it from the present floating debt.

The Tecnomasio Italiano Cabella of Milan, which manufactures electrical apparatus and machinery, and which has not been in a flourishing condition for some time past, has now been converted into the Tecnomasio Italiano Brown-Boveri, as a result of an agreement which has been entered into between the former and the Swiss firm of Brown, Boveri & Co., of Baden, while the branch maintained by the latter in Milan has also been merged into the new combination. In future the Swiss company will undertake the technical management of the Italian company, in which it has acquired a large financial interest. The agreement, which has been arranged for 25 years, provides that the whole of the orders received by the Tecnomasio for Italy, the Levant and the Balkans shall be equally

divided with the Swiss company, which will also benefit to the extent of a commission on the invoice value of the electrical manufactures of the Italian enterprise.

The Italian Electro-chemical Co., which was originally formed with a capital of £260,000, has had to overcome considerable difficulties in consequence of severe competition and the fact that the share capital was insufficient for the requirements of the company. It has, therefore, been necessary to write down the capital by 40 per cent., and to issue new shares amounting to £108,000, and to convert the floating debt of £110,000 into a bonded debt. The company owns two water-power concessions, one being on the River Tinno, near Bussi, of 6,300 H.P., and the other of 38,500 H.P. on the River Pescara, although only a portion of the first is utilised. In addition to these, the company has two works near Bussi and Piano, which are engaged in the production of chemicals.

PRACTICAL EXAMPLES WITH THE CALCULATOR BOARD.

By EDWARD RAYMOND-BARKER.

Series I.—*Notes for Submarine Cable Staffs.*

An article descriptive of the calculator board appeared in the Electrical Review of August 28th, 1903. The result

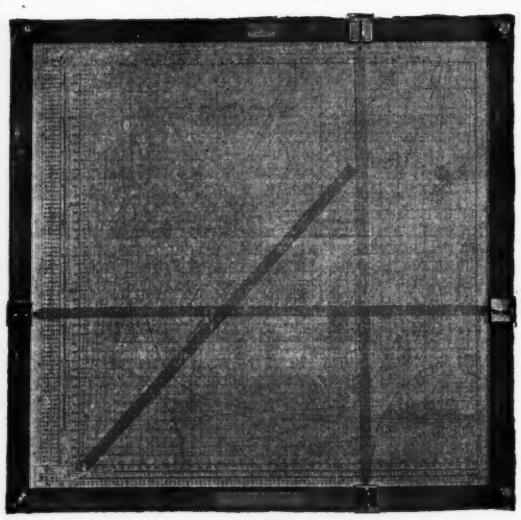


Fig. 6.

has been a spontaneous and widespread interest, the genuineness of which, it may be added, has been shown in a manner essentially practical.

The following notes, the appearance of which has been somewhat delayed owing to other work and many calls upon the writer's time, have been arranged as a sequel to the above-mentioned article, and for the purpose of placing on record in the clearest manner possible, a series of practical examples easily and quickly worked out by the crosswise adjustments of the calculator board cursors.

The illustrations are numbered in sequence with those in the afore-mentioned article.

These notes have been written specially for the benefit of those officials at cable stations responsible for the routine cable tests, and for the localisation of any cable breaks that may occur.

The fact that the deviser of the calculator board is a man who in the past has had practical experience in the responsibilities of a superintendent and electrician at an important cable station, is sufficient reason for the devoting of the present series of examples, more or less exclusively, to cable station matters.

At a modern cable station worked constantly at high pressure, the calls upon the time and energies of the more responsible men on the staffs are often so onerous, especially in unfavourable climates, that it may be truly said that any man who devises means for simplifying, *i.e.*, expediting any one branch, only, of so complex a routine, deserves well of his fellow workers. In any case that has been the aim of the deviser of the calculator board. Whether he has succeeded experience only can show.

What has here been said about simplifying and expediting tests at cable stations refers also, and with extra force, to

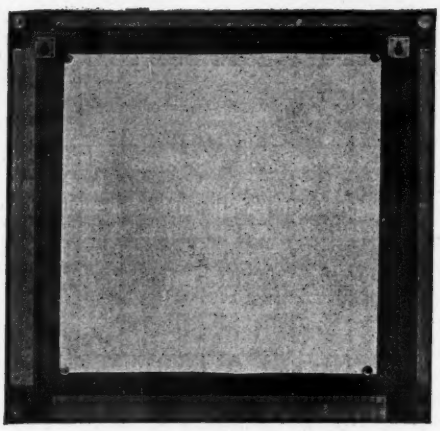


Fig. 7.

the requirements of the cable ship testing room, where every time-saving appliance is hailed as a boon to its users.

Although the examples in the following series deal mostly with cable work, some of the examples, especially those relating to temperature coefficient corrections, will, perhaps, be of more general use in electrical laboratories.

With regard to the correction of bridge coils for temperature, the admirably simple and ingenious method devised by Mr. John Gott for the automatic elimination of error due to difference in temperature, does not do away with the necessity for knowledge as to the application of such corrections, should circumstances necessitate their adoption.

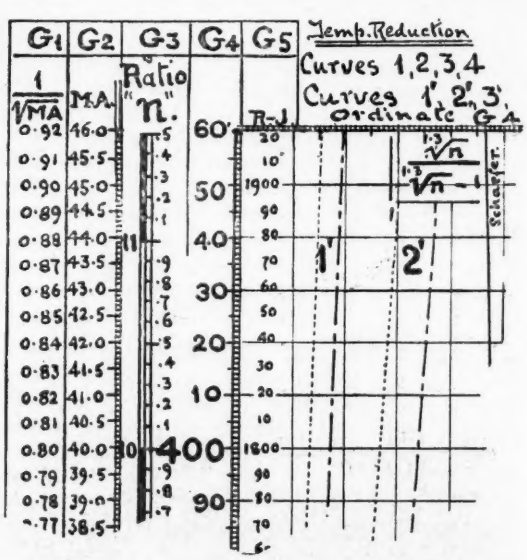


Fig. 8.

Fig. 6 is from a photograph of the finished calculator board, about 21 in. sq. overall, the general construction and working of which have been described in the former article already alluded to.

Fig. 7 gives a view of the back of the board arranged with scales, so as to constitute an improved drawing board of an exceedingly convenient kind.

For figs. 6 and 7 the writer is indebted to Messrs. W. Watson & Sons, of 313, High Holborn, the makers of the calculator board.

Figs. 8, 9 and 10 show, full size, three portions cut from the electrical curve sheet devised by the writer for use with

the calculator board, which, as has been pointed out, can be adapted for any line of quantitative research.

Fig. 8 is the upper left corner of the curve sheet; fig. 9 the lower left corner, and fig. 10 the lower right corner.

Fig. 8 shows clearly the numeration of the various scales of ordinates—easily distinguishable by their several headings.

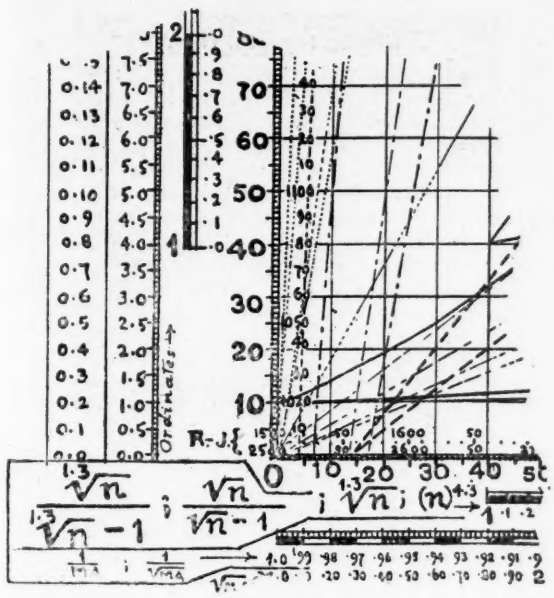


FIG. 9.

Fig. 9 shows the lower extremities of the ordinate scales, also the origin of the abscissa scales.

Fig. 9 makes it clear how easy it is to associate each particular scale with the various formulæ appertaining to that particular scale. The formulæ are inscribed in line with their several scales, so that identification of the various scales is easy.

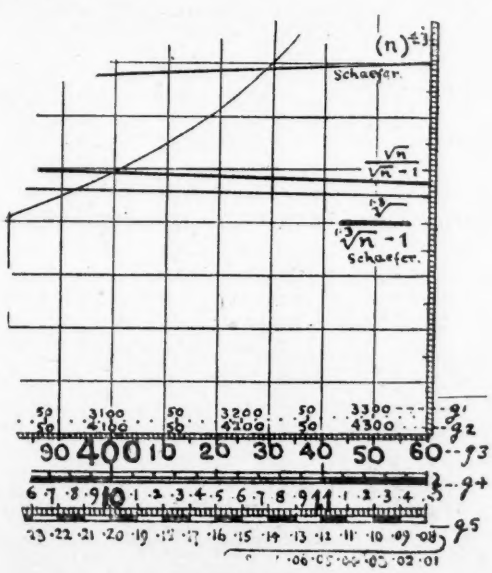


FIG. 10.

Fig. 10 shows the right hand extremities of the abscissa scales. It will be noticed that 0·08 to 0·01 on scale g_5 apply to that portion of the $\frac{1}{ma.}$ curve which, on the curve sheet, has been moved 35 mm. to the left of its correct position, in order to keep it within the limits of the curve sheet.

The diagrams which illustrate the following examples have been obtained from the calculator board, and have been photographically reduced for the purposes of this article. Naturally, on this reduced scale, only the main points on the graduated scales are shown.

In each case, that curve and its corresponding scales only are given, of which there is need in the expression or operation to be solved. Thus all confusion is avoided, and the student, or the young assistant in the testing room, who, at first, may have been alarmed at the rather formidable appearance of the curve sheet, will recognise the absolute simplicity of its method of operation, and its great value in regard to expeditious work and saving of precious time.

As regards those members of cable staffs desirous to become proficient in the best tests, or whose official position necessitates an intelligent conception of the best methods of procedure, any man who has made himself fairly familiar with the text-books now at his disposal, will at once appreciate the advantages attaching to the calculator board.

The serviceable books by Baines, Wilkinson, Fisher and Darby, and Elton Young—taking them, more or less, in progressive order—have resulted in bringing together, and presenting to cable staffs, up-to-date information as to modern test methods.

Mr. J. Elton Young's was the first text-book to give the Schaefer curves, three of which figure on the calculator board curve sheet, re-calculated on an extended scale. It follows, therefore, that a consistent student of Elton Young has little to learn, and nothing to fear, in the matter of curves.

The writer has dilated somewhat upon this point, as there has been a tendency in some quarters to opine that the average cable station official and practical cable telegraphist would regard a curve as too complex a device for ordinary every day use.

EXAMPLES.

Example 1.—To calculate battery power to give certain milliamperes (ma.) through a given approximate resistance in ohms (ω). Reproduction of deflection method.

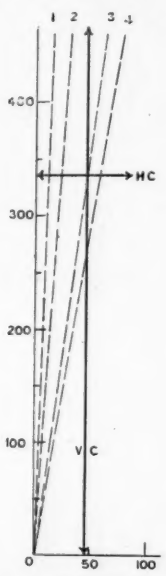


FIG. 11.

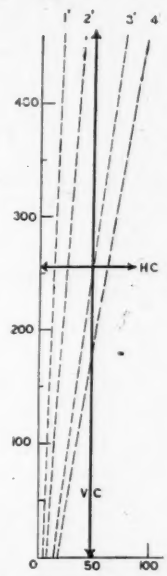


FIG. 12.

A test is made to a cable break by reproduced direct deflection method. Required battery powers in terms of Leclanché cells, to drive 5, 10, 20, 25 ma. through a resistance which a preliminary test has shown to be approximately 3,350$^{\omega}$ including shunted galvanometer.

Fig. 11, in which, as in all subsequent diagrams, each cursor strip is represented by a line, thus ←→ or ↕, illustrates the third case stated.

Ordinate :—G_4 (*omnibus* scale) 100 mm. = 1,000$^{\omega}$.
Abscissa :—g_3 (*omnibus* scale) 100 mm. = 100 cells.

Bring horizontal cursor (H.C.) to 335 mm. = 3,350$^{\omega}$.

Bring vertical cursor (V.C.) successively to points where curves 1, 2, 3, 4, are intersected by H.C., and read, at extremity of V.C. on scale g_3, result :—

12, 23, 46 (as shown in fig. 11) and 57 cells Leclanché.

Example 2.—To calculate battery power to give certain ma. through approximately known resistance, when Wheatstone bridge employed.

A test is made to a cable break by Wheatstone bridge method. Bridge ratio = $1{,}000^{\omega}$: $1{,}000^{\omega}$. Required the battery powers to drive 5, 10, 20, 25 ma. through cable side of bridge system, and a cable resistance of approximately $2{,}555^{\omega}$, including resistance of milliampere meter.

Ordinate :—G_4 (omnibus scale) 100 mm. = $1{,}000^{\omega}$.
Abscissa :—g_8 (omnibus scale) 100 mm. = 100 cells.
Bring h.c. to 255·5 mm. = $2{,}555^{\omega}$.

Bring V.C. successively to points where curves 1′, 2′, 3′, 4′, are intersected by H.C., and read at g_8 12, 24, 48 (as shown in fig. 12), and 60 cells, Leclanché.

In this instance let results be checked by the figures involved :—

$$\frac{25\ (2{,}555 + 1{,}000)}{1{,}000 \times 1{\cdot}485} = 59{\cdot}87 = 60 \text{ cells.}$$

$$\frac{20\ (2{,}555 + 1{,}000)}{1{,}000 \times 1{\cdot}485} = 47{\cdot}9 = 48 \text{ cells.}$$

$$\frac{10\ (2{,}555 + 1{,}000)}{1{,}000 \times 1{\cdot}485} = 23{\cdot}95 = 24 \text{ cells.}$$

$$\frac{5\ (2{,}555 + 1{,}000)}{1{,}000 \times 1{\cdot}485} = 12 \text{ cells.}$$

NOTE :—Further memoranda relating to batteries are inscribed on the curve sheet.

(To be continued.)

CORRESPONDENCE.

[*Letters arriving after first post on Wednesday morning cannot appear until the following week.*]

Automatic Fire Alarms.

I have just been reading Mr. Oatway's letter on the subject of "Automatic Fire Alarms," which appeared in your issue of the 2nd inst., page 535. I have no intention of re-opening this discussion with a lengthy reply, for I think I have already fully expressed my views on the subject, especially as regards syntonisation, concerning which Mr. Oatway seems to have no serious argument to bring forward. But there are some points in Mr. Oatway's letter which I cannot allow to pass unchallenged, and I therefore appeal to you to afford my reply a place in your columns. Mr. Oatway concludes his letter thus :—

I am quite willing to take up the wireless method of transmitting alarms of fire when any advantage can be obtained from it. At the moment, dealing with the conditions which exist, if the merit claimed was indisputable, *the requirements of the fire service and considerations of economy would prohibit its use in this country.*

This conclusion is so little in accordance with the facts brought out by the discussion, and even with Mr. Oatway's letters, that I cannot help thinking that he has made a mistake, and that the last two lines of his letter relate to the ordinary alarms, and not to wireless ones. In fact, the best argument that Mr. Oatway seems to be able to bring against the wireless fire alarm is the following :—

I have only been able to establish at Glasgow 25 of my alarms.

There is nothing surprising in this, when we consider the inconveniences which are entailed by the ordinary alarms, and to which I called attention in my former letters. The wireless alarms are exactly suited to supplement the number of these installations, as they avoid the inconveniences in question and lessen the cost.

These are the figures relating to the expenditure in the two cases :—The yearly expenses for Mr. Oatway's apparatus amount to £5 10s. on an average, or 136·50 fr., which, at 3 per cent., means a capital of 4,550 fr. My transmitting apparatus costs 500 fr. I have estimated the yearly upkeep at 6 fr. per apparatus, which thus requires a capital of 200 fr. Thus my apparatus requires a capital of 700 fr., as against 4,550 fr. for Mr. Oatway's.

I leave it to your readers to draw their own conclusions. I will conclude by saying—with regard to the Siemens apparatus—that, as I have already said in my letter which appeared on p. 212 of your issue dated August 7th, the report of Mr. Oatway's speech to which I referred, was that published in the ELECTRICAL REVIEW for July 17th.

E. Guarini.

[This correspondence is now closed.—EDS. ELEC. REV.]

Winding Induction Coils.

In connection with your description of the new method of winding secondaries of induction coils, I should like to say for general information that the *method* of winding may be new, but the idea is not. During the South African war (some time in 1900) my firm in Durban repaired for the Imperial Government (as distinct from the Colonial Government) a coil, the secondary of which was wound in this manner. From my recollections it was a 10 or 12-in. for X-ray work, and broke down very shortly after being put into service. It was a very well made article, and entirely protected in polished teak case for field use, the ebonite discharging pillars unscrewing. I have tried to recollect the maker's name, but cannot at this distance of time. However, I can assure you that it was wound exactly in the manner you ascribe to Mr. Leslie Miller, and we found it an extremely awkward job to rewind. The number of sections was very large. In the many coils, large and small, I have repaired in my time, I have never before come across this method. Still it did not save the breakdown of the secondary.

Fred. H. Hadfield, M.I.E.E., M.S.A.

London, *October 19th*, 1903.

Single-Phase Alternate Current Motors.

I notice in your issue of the 9th inst. a short notice concerning a motor being manufactured by Messrs. Ferranti, Ltd., of Hollinwood. It seems clear to me, from the description, that all novel features claimed for this machine were embodied in the motor alluded to in my letters published in the ELECTRICAL REVIEW on October 28th and December 12th, 1902. I may add that the motor therein described has been patented by me more than a year ago, and possesses a certain number of additional advantages which do not seem to be embodied in the Schüler-Ferranti motor.

Val. A. Fynn.

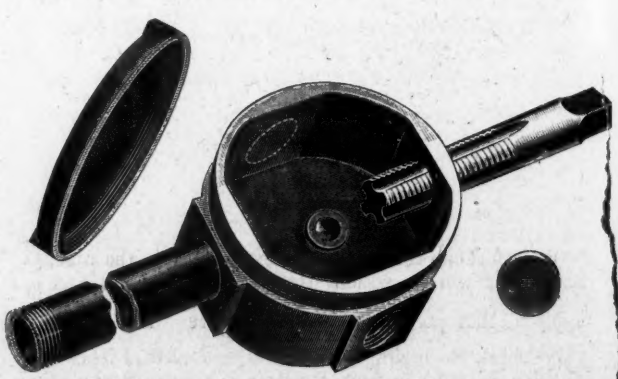
Bradford, *October 14th*, 1903.

DEVICES AND FITTINGS FOR THE CURRENT ELECTRIC LIGHTING SEASON.

(*Continued from page* 618.)

ARMORDUCT JUNCTION BOX.

The Amorduct Improved Electric Conduit Co, of 5, St. Nicholas Buildings, Newcastle-on-Tyne, have just registered a new junction box. It embodies an entirely new method of fixing the lid by



threading the top of the box, and tapping the inside of the lid. The necessity for screws or clamps is thus obviated, and a perfectly water-tight fit is secured, adding at the same time to the appear-

ances of the box. The illustration shows a two-way box (tapped ready, two-way) and two knock-out holes are provided which leave room for future extensions, as shown by the example in the case of the right hand hole, which is in the process of being tapped. The company supply it as an ordinary junction box, and also in connection with their china outlet fittings. In the case of self-contained fittings, the small projection shown on the bottom of the box is tapped and used for securing a universal base, which in turn is adapted as a ceiling rose, wall plug, thumb switch, ceiling lampholder, or other fittings, the cast-iron lids of the boxes being suitably bushed. Where this is preferred the fittings can be mounted on the lids of the boxes (which in that case consist of insulating material) which are suitably recessed and drilled to take any standard fittings. The company is now supplying "Armorduct" in a second extra heavy quality. We have received an advanced copy of a circular which is now being prepared to show the advantages possessed by the system. The company already has an interesting price list in circulation and copies can be obtained on application.

G.E.C. Fittings and Appliances.

The new suite of showrooms now open at the General Electric Co.'s address in Queen Victoria Street, E.C., contains an up-to-date and artistic array of electric light fixtures suitable for all branches of the trade. From the modest bracket or pendant for use in the office, to the beautifully modelled electrolier, everything is shown in its proper surroundings. Chief among the novelties on view are the new "Cascade" shade ornaments. These readily adapt themselves to existing fixtures, and when fitted to electroliers, brackets, pendants, &c., the effect is most artistic. A fringe of cut-glass tubes and beads in various colours and threaded on wires, give this pleasing effect, and while adding to the beauty of the fittings, do not absorb the light, but add to its diffusion. A further recommendation is, that owing to wire being used for threading instead of the usual cotton or thread, the fringe is more easily cleaned.

G.E.C. Curling Iron Heater.

G.E.C. Ornamental Radiator.

An improvement in lampholder interiors is noticeable in the G.E. Co.'s new pattern which is just placed on the market. The vexed question of "shorts" appears to have been the subject for attention, and this new pattern is produced in the hope of dispelling the trouble that is frequently experienced. The lampholder interior consists of two porcelain parts, and the necessary plungers and terminals. On the base are screwed all the necessary brass parts, and a porcelain cover fits over the whole, leaving only the plungers visible, and so ensuring complete insulation from the case of the lampholder.

A new departure in the capping of the well known "Robertson" lamps is now being put forward; the improvement is made without increasing the price of the lamp. Large consumers must continually experience annoyance by the unauthorised use of high candle-power lamps, and the G.E. Co. have, therefore, decided to supply special incandescent lamps of 8 c.p. with three-pin caps (known as the "A.B.C."), instead of the usual two pins. The pins are not equi-distant from each other, but are so placed that only the special lamp can be inserted, it being impossible to use the ordinary two-pin cap in the special holder which is, of course, required.

The latest patterns in electric glow radiators can also be seen in the showrooms of the G.E. Co. Their new types are known as the "Jupiter" and "Orion" radiators.

The "Jupiter" radiator is wired for four lamps, which are controlled by two switches, and being placed well away from the metal parts of the radiator, are not liable to damage. The design is in cast-iron, both sides and the back being completely enclosed. The base gives support to pillars of polished and lacquered brass, surmounted by an ornamental frieze of either cast-iron or brass. The reflector consists of highly polished aluminium.

The "Orion" radiator is very similar in design, and is most finely cast. The standard finish is black enamel, but when relieved in gold an artistic result is obtained. This radiator has five heating lamps controlled by three switches.

A new pattern curling-iron heater is also now being shown. The design is very tasteful, the metal parts being heavily nickelled and mounted on a marbled base. A distinct feature of this heater is that the current is switched on by simply inserting the tongs, and automatically disconnected when they are taken out.

G.E.C. "Cascade" Fittings.

Westminster Arc Lamps.

The Westminster Engineering Co., Ltd., of Victoria Road, Willesden Junction, has issued some lists of its Westminster enclosed arc lamps, photo-printing arc lamps, and portable battery booster. We illustrate in fig. 1 the mechanism of the No. 108 lamp, and in fig. 2 one of these lamps is shown with an ornamental cover. It is an enclosed type of lamp, with a single globe 7 in. in diameter. The burning life with one pair of carbons and 5 amperes is 80 hours, or with 6 amperes, 70 hours. The regulation is effected by means of two solenoids operating a brake wheel. The positive carbon holder is suspended by a flexible copper cord, the other end of which is coiled round a spring drum; this drum is fixed on the same spindle as the brake wheel, and the contained spring automatically takes up any slack on the flexible cord, as, for instance, when the lamp is re-carboned. The carbon holder is guided in the centre tube by three rollers to ensure a minimum of friction. The

globe is fitted to the lamp as shown, the bottom plug being attached by a bayonet joint. The globe is carefully ground on the top edge to ensure a good joint with the metal plate, and the spiral spring at the bottom of the globe gives the necessary pressure to keep the joint tight without any packing whatever, and at the same time to act as a safety valve for the escape of gases, should the pressure be

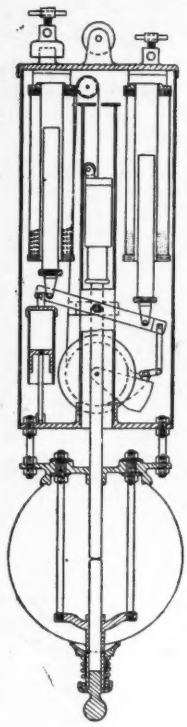


Fig. 1.

Fig. 2.

Westminster Arc Lamps.

too high, as when the lamp is switched on again shortly after being extinguished. The space between the globe and the body of the lamp keeps the working parts comparatively cool.

Veritys' Electric Radiators.

We recently mentioned in our columns Messrs. Veritys' list of electric radiators for the present season, and we now illustrate one or two designs contained therein. Fig. 1 represents what is about as simple as anything of the kind well could be. It is a very cheap type, consisting of two or four heat lamps and very little else. It is suitable for bathrooms, and such situations where it is desirable to take the chill off the atmosphere. The same stove is, if required,

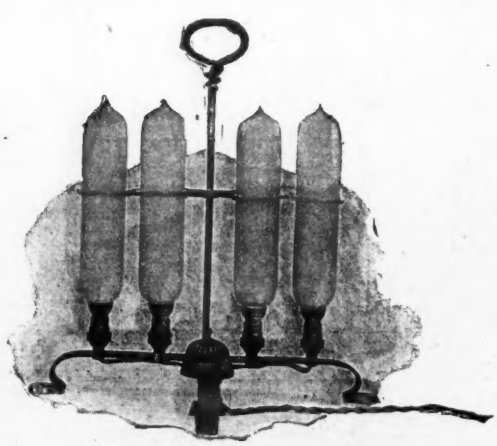
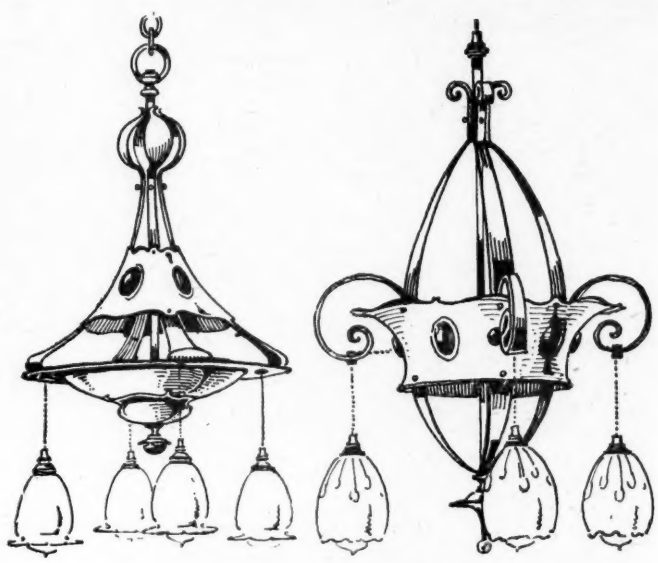


Fig. 1.

supplied with a polished copper reflector to direct the heat rays where required. Fig. 2 shows a more ornamental type of small radiator suitable for more important dwelling rooms, and as it is listed in antique copper, or oxidised silver, it should harmonise with much of the metal work now in vogue. There are several other useful and ornamental stoves in Messrs. Veritys' circular (No. 65), for copies of which electrical contractors should make application.

"Pewtal" Art Fittings.

Owing to the constant trouble to clients caused by metals oxidising and rusting through exposure to the atmosphere, Art Fittings, Ltd., of 112, Victoria Street, S.W., have experimented with metals and have produced an alloy, which they have registered under the name of "Pewtal;" this alloy resists oxidisation, and although requiring no protective lacquer, is permanent in colour, and therefore needs no cleaning whatever. When once a fitting is fixed it never has to be repolished like other metals. This alloy is light in weight and capable of artistic treatment to the same extent as copper or steel, and we understand that architects and engineers are adopting "Pewtal" for electric fittings very largely. The natural colour of this metal is similar to oxidised silver, although it can be treated to represent dark armour steel, the colour still remaining permanent. Members of the electrical trade who are interested in "Pewtal" should pay a visit to the showrooms of Art Fittings, Ltd., to see some of the designs which have been executed in this alloy, and they may be sure of a cordial welcome. These designs, while being artistic and thoroughly



"Pewtal" Fittings.

practical in every way, are free from the monstrosities which are occasionally produced by some workers who, in striving after something "original," over-ride every other feature in their designs. The accompanying illustrations show some fittings executed in "Pewtal."

Siemens's Lighting Appliances.

From the Siemens Electric Appliances, Ltd., of Watling Street, E.C., we have received various leaflets respecting their electric lighting appliances which are now before the trade. Their "Liliput" arc lamp, which has already been described in the Electrical Review, is made in two forms, for indoor and outdoor

Fig. 2.

lighting; and some other lists show a number of different designs of electroliers and standards made to take the lamp. The "Siemens" new high-voltage cartridge cut-out, and the firm's arc lamp wire coupling and accessories for suspending arc lamps, already familiar to our readers, are detailed and priced in other sheets.

Cryselco Lamps.

In anticipation of the present season, Cryselco, Ltd., of Kempston Works, Bedford, have put down labour-saving appliances (which, unfortunately, had to be obtained in America) in order to enable them to make more uniform lamps at a decreased cost, the output of one machine equalling that of eight girls. The "Cryselco"

incandescent lamp is made entirely by mechanical appliances, it only being handled in passing from one machine to another. This lamp has been adopted as the company's standard for this season, and there is every prospect that this year's output will greatly exceed last year's record.

Simplex Conduit Specialities.

The latest improvements introduced by the Simplex Steel Conduit Co., Ltd., consist of some new mountings for switches, ceiling roses, &c. All lug mounted switches, ceiling roses, wall plugs, cut-outs, &c., are now mounted with special regard to obtaining perfect insulation from the accessories to the metal conduits. A thick insulating disc is first screwed to the top of the company's standard

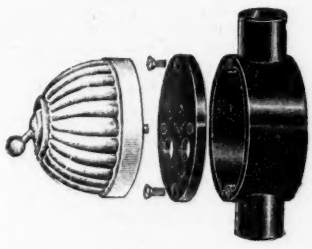


Fig. 1.

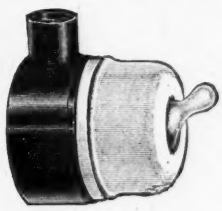


Fig. 2.

iron boxes forming a non-conducting lid by means of countersunk metal screws, the heads of the screws being below the surface of the disc when screwed down. The porcelain fitting is then fixed to this disc by means of metal screws, tapped holes being made in the disc to receive them. The disc is heavy and rigid enough for a solid grip to be obtained. The holes on the discs for fixing the accessories on are almost at right angles to the holes provided for the holding down screws, and it will thus be seen that this method of mounting has great advantages over the system of screwing the switches, &c., direct on to the metal box with screws. Fig. 1 shows a switch with insulating disc and box taken apart, and fig. 2 a switch mounted in position on the box. The company has also introduced a spring lid mounting for special cases

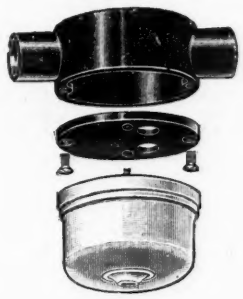


Fig. 3.

where the minimum projection is required; it consists of a ring which accurately fits into the top edge of the box, and is, to all intents and purposes, one of their patent spring-in lids, punched so as to fit round between the base and cover of a switch or other accessory, thus allowing the base to be partly sunk into the box. This makes a good job with as small an amount of projection as possible, measured from the bottom of the box, and, where desired, these fittings are supplied with two screws in the box so as to prevent the lid from being displaced by any unusual strain being put upon the switch, tending to pull it away from the box. Fig. 3 shows this method of mounting as applied to a patent three-contact ceiling rose.

The Simplex Co. has also recently introduced its wireduct conduit to meet a demand which exists for a strong screwed and watertight conduit possessing a perfectly smooth interior and exterior surface at a small cost. This new conduit is manufactured to exact and uniform diameters in the usual sizes from ½ in. to 2 in., from specially selected steel strip of stout gauge, and the ends are united by a special process which renders the conduit quite free from internal burrs and also makes it watertight.

ELECTRICITY FOR SMALL HOSPITALS.

By W. NOBLE TWELVETREES, A.M.I.E.E., M.I.Mech.E.

(Abstract of a Paper read before the Sanitary Institute at Bradford, July, 1903.)

In this paper the author deals with the relative efficiencies of steam, gas and oil engine-driven electric lighting installations, and direct gas and oil lighting for small hospitals. Although the paper does not add anything to the present stock of information on the subject, yet it will, no doubt, be welcomed for purposes of reference.

The author takes, as a basis of comparison, an installation consisting of 155 16-c.p. lamps, recently equipped under his direction. This installation was designed simply for lighting, but it would be quite capable of dealing with a moderate power-load in addition. The capacity of the plant is 10 kw., or 100 amperes at 100 volts, which is sufficient for the continuous supply of 155 16-c.p. lamps. The storage battery has a capacity of 216 ampere-hours when discharging in 6 hours. This capacity is sufficient for the present requirements of the institution, and is equivalent to an annual output of about 8,000 Board of Trade units. Motive power is provided by a quick-revolution vertical engine, driving a belt-driven bipolar continuous-current dynamo, and steam is furnished from the boiler provided for the general supply of heat and power for ordinary purposes. The cost of the machinery and plant, erected in working order, was £475; but to this should be added the amount of £100 to cover the increased cost of boilers, owing to the higher pressure necessary for the electric light plant. The total capital expenditure is thus brought up to £575.

In considering the further outlay required to make the plant available for power as well as for light, it is only necessary to add the cost of providing and fixing a booster, say £100; as the value of the laundry engine and auxiliaries is about the same as that of the electric motor and fittings that would be required instead. Thus, £675 represents the total capital value of the plant for light and power. If fully employed for light and power during five days a week, and for light alone during the remaining two days, the annual output would be 23,000 units.

Calculated upon the amounts stated above, the annual repayment of principal with interest at 3 per cent., extending over 20 years, would be £40 for lighting alone, or £47 for light and power. The amount to be included in the total cost of energy on account of repayment and interest is consequently 1·2d. per unit in one case, and 0·5d. per unit in the other.

With coal at 15s. per ton and outputs of 8,000 and 23,000 units for light and power respectively, the author arrives at the following figures:—

Estimated Cost of Electrical Energy in Hospital Installation. In Pence per Board of Trade Unit.

	Light only.	Light and power.
Fuel	·80d.	·80d.
Water and engine room stores	·07d.	·07d.
Attendance (extra)	·55d.	·20d.
Maintenance	·75d.	·37d.
Works cost ...	2·17d.	1·44d.
Repayment and interest ...	1·20d.	·50d.
Total cost ...	3·37d.	1·94d.

The author draws attention to the necessity for efficiently arranging all details of the plant in order to secure the best results.

It may from circumstances be considered advisable to adopt gas engines; in places where steam is not required for other purposes, this type of engine provides power more cheaply than the steam engine, and one great advantage it possesses is that of adaptability to intermittent work. When the engine is stopped the consumption of fuel instantly ceases, whereas in the case of the steam engine, there is continuous waste of fuel during the intervals of work. Hence the internal combustion motor is particularly suitable for very small institutions, where the general demand for steam is of limited extent.

Various gas engines are now to be obtained in which the consumption per brake horse-power is between the limits of 15 cb. ft. and 25 cb. ft. per hour. As our attention is devoted particularly to electricity for small hospitals, we will take the consumption of gas at the upper limit of 25 cb. ft. per b.h.p.-hour, or, say, 37·5 ft. per kw.-hour. With gas at 2s. 6d. per 1,000 cb. ft., the cost of energy works out at about 1·12d. per unit. Substituting this value for the cost of coal given in the first table, we find the total cost of generating energy in a gas-driven plant to be 3·69d. per unit for light alone, or 2·26d. per unit for light and power. At the average rate of 30 cb. ft. per kw.-hour, the cost of production would be 3·47d. in one case and 2·04d. in the other. No alteration is necessary in the item referring to repayment and interest, because the higher cost of the gas engine practically balances the saving in respect of the amount allowed for increased boiler power.

Light given in Direct Lighting by One Cubic Foot of Gas.

Type of burner.	Candle-power-hours.
Batswing	2·75 to 3·00
Argand	3·00 to 3·50
Incandescent	12·00 to 15·00

When consumed in a gas engine at the rate of 37·5 cb. ft. per kw.-hour, each cubic foot of gas will give 6·65 c.p.-hours in the form of electric light—approximately 2·3 times the light furnished by an ordinary burner, twice that by an Argand burner, and half that by an incandescent burner.

A matter of much importance from the hygienic standpoint is the effect of illuminants upon the atmosphere of the space in which they are burned. The following table is taken from Dr. Louis Bell's recent work, "The Art of Illumination." Another argument

Vitiation of Air by the Combustion of Oil and Gas (Bell).

Illuminant.	Quantity per hour.	Candle-power.	Oxygen consumed. Cb. ft.	CO_2 produced. Cb. ft.	H_2O vapour. Cb. ft.	Vitiation = adult persons.
Paraffin oil ...	992 gr.	16	6·2	4·5	3·5	7·5
Kerosene oil	909 gr.	16	5·9	4·1	3·3	7·0
Gas (Batswing)	5·5 c.f.	16	6·5	2·8	7·3	5·0
„ (Argand)	4·8 c.f.	16	5·8	2·6	6·4	4·3
„ (Welsbach)	3·5 c.f.	50	4·1	1·8	4·7	3·0

in favour of electric light is to be found in the deterioration of painted, distempered, and other surfaces in buildings where gas is employed for direct lighting, and it is possible that the cost of re-decoration may frequently equal, if it does not exceed, the difference between the two methods of illumination.

The oil engine offers another alternative to steam for the generation of electrical energy, in many cases more convenient and economical than the gas engine, especially where no public supply of gas is available. The consumption in well-designed engines, as small as 7 B.H.P., is not more than 0·82 lb., or one-tenth of a gallon, per B.H.P.-hour. Allowing 1·2 lbs., or 0·15 gallon, per kilowatt-hour, the cost of oil at 4d. per gallon does not exceed 0·6d. per unit of energy produced. Substituting this value for the cost of coal as stated in the first table, we find the total cost of energy from an oil-driven plant to be 3·17d. for light alone, or 1·74d. for light and power. As before, no alteration has been made in respect of repayment and interest, as the value of the plant remains practically unaltered.

Comparing the efficiency of oil used for direct lighting, and for lighting by electricity through the medium of an oil engine, we find a considerable advantage follows the latter method of procedure. The following is a summary of some results obtained by Prof. Vivian B. Lewes from a selection of twelve different lamps in use at the present day:—

Consumption of Oil in Direct Lighting, in Grains per Candle-power, per Hour (Lewes).

Type of wick.	American oil.	Russian oil.
Circular	60·32	75·11
Flat, single	62·63	74·00
Flat, duplex...	53·70	51·15
Average	58·88	66·75

Taking the general average of 63 grains per candle-power as the basis of calculation, we find that the consumption of 63 grains of oil in an engine, at the rate of 1·2 lbs. per kilowatt-hour, would produce 1·87 C.P.-hours in the form of electric light, nearly double the amount obtained by direct lighting.

Another form of fuel which is rapidly coming into general use is producer or power gas. In some parts of the country arrangements are already being made for the distribution of this gas on a large scale, and as it can be produced from the cheapest forms of fuel, the sale price will probably not exceed 2d. per 1,000 cb. ft. Allowing for the lower calorific value of this product, the equivalent cost would be about 8d. per 1,000 cb. ft. In a plant of the size previously defined, the use of power-gas would reduce the cost of fuel to about 0·2d. per unit, and the cost of electricity to about 2·77d. per unit for light alone, or to 1·34d. per unit for light and power.

The following tables are also of interest:—

Estimated Cost of Electrical Energy in Hospital Installation, in Pence per Board of Trade Unit.

Motive power.	Cost of production.			
	Plant partly used.		Plant fully used.	
	Works cost.	Total cost.	Works cost.	Total cost.
Steam engine; coal at 15s. per ton	2·17	3·37	1·44	1·94
Gas engine; gas at 2s. 6d. per 1,000 cb. ft.—				
Average consumption ...	2·27	3·47	1·54	2·04
Maximum „ ...	2·49	3·69	1·76	2·26
Oil engine; oil at 4d. per gallon	1·97	3·17	1·24	1·74

Cost of Gas and Oil for Direct Lighting, in Pence for a Quantity Producing the same Candle-power-hours as One Board of Trade Unit of Electricity.

Illuminant.	Average of various burners.	Batswing burner.	Argand burner.	Incandescent burner.	
				New.	At 300 hours.
Gas at 2s. 6d. per 1,000 cb. ft.	1·54	2·61	2·30	·56	·75
„ 3s. „ „	1·82	3·1	2·76	·67	·80
„ 3s. 6d. „ „	2·14	3·6	3·23	·78	1·05
Oil at 4d. per gallon ...	1·12	—	—	—	—

The figures are merely intended to represent the cost of energy at the switchboard, or of illuminating material at the point of distribution. It is, however, impossible to institute an exact comparison between the calculated cost of electricity per unit and the equivalent cost of gas and oil, but similar ratios will generally exist between the costs of the various methods of producing power and light.

The following conclusions may be drawn from the foregoing investigation:—

1. That electrical energy can be generated in a hospital of moderate size, even under unfavourable conditions, at a cost considerably lower than the average rate charged by public supply corporations.

2. That economical production is greatly aided by utilisation of the generating plant for power as well as for light.

3. That under favourable conditions energy can be generated at such cost that electric lighting becomes less costly than direct gas lighting when ordinary burners are employed, although more costly than gas lighting by incandescent burners, and more costly than direct lighting by oil lamps.

4. That, in view of its deleterious effect upon the atmosphere, the combustion of gas and oil for the direct lighting of hospitals is distinctly inadvisable; and that these substances may be more advantageously employed in the provision of motive power.

5. That the facilities offered by modern gas and oil engines are such as to place electricity within the reach of all hospitals, for which the outlay upon generating plant has hitherto been regarded as unjustifiably heavy.

[Mr. Noble Twelvetrees does not appear to have taken into account the possibilities of the Nernst lamp, in making his calculations. As their adoption might result in less than half the energy being required for the same candle-power-hours, the cost comparison with other illuminants would, in that case, greatly favour electricity.—Eds. Elec. Rev.]

SOUTH AFRICAN NOTES.

(From our Special Correspondents.)

Natal Harbour Department.—It is proposed to fit with electric light all the dredgers used for reclaiming the Harbour to enable them to be worked all night. An expenditure of £2,000 per installation is estimated.

A Durban Presentation.—Mr. A. Mitchell, R.N.R., the chief engineer at Durban for Messrs. Dick, Kerr & Co., who superintended the erection of the power plant for the Durban Corporation tramways, and last month completed his work, was entertained at a farewell dinner in the Central Hotel, and was presented by his late staff with a silver flask and cigar case suitably engraved. The presentation was made by Mr. G. A. Webb, A.I.E.E., who was responsible for the electrical work, and had acted as assisted engineer to Mr. Mitchell throughout. Mr. Mitchell is shortly proceeding to England. He had been engaged at Durban for about 18 months (arriving from Camp's Bay, where he superintended the erection of that plant in February, 1902). Three months later, on May 1st, 1902, he had erected two 250-KW. sets to enable the Durban Corporation to open its tramways on that date, and to show its appreciation of his expeditious work under very trying circumstances, such as temporary buildings, &c., the Durban Corporation unanimously voted him £100 as a present. Messrs. Ross & Jagger, who were previously engaged on Mr. Mitchell's staff, have commenced business as mechanical, electrical and general engineers at 29, Lynn Buildings, Commercial Road, Durban.

Pietermaritzburg.—The first actual work in connection with the construction of the tramways permanent way was performed by the Mayor. It is expected that the first section will be working in six months.

Kroonstad.—The Municipal Council has been inviting tenders until October 15th for the lighting of the town by electricity.

Bloemfontein.—Messrs. Fuchs, Arnold & Co. have started business here as electrical engineers. The electric lighting extension scheme, so eagerly waited for, is now completed.

Johannesburg.—Messrs. Mordey & Dawbarn's electric lighting scheme included the following townships:—Yeoville, Berea, Bellevue, Bellevue East, Troyeville, Lorentzville and Houghton Estate. Numerous requests for electric light have recently been received from residents in suburban districts not included in the scheme, and the Tramway and Parks Committee instructed the manager of the Light and Power Department to make an inspection of the most populous of the districts not provided for, with a view to ascertaining their probable requirements. As a result of his investigation, the Committee has recommended the Council to instruct the consulting engineers to include the following townships in their general lighting scheme:—La Rochelle and Rosettenville, Ophirton, Booysens, Turffontein, Forest Hill, Kensington, Denver, Auckland Park, Auckland Park Estate and Melville.

The Rand Central Electric Co. will be in a position to increase the supply of current from Brakpan from 700 KW. up to a maximum of 800 KW. in four months from the present time. The Committee submit a long report on the matter, and recommend that their action in informing the Rand Central Electric Co. that the Council will be prepared to accept, under the contract with the company, a supply of an additional 100 KW. (raising the total supply from the company to 800 KW.) be approved; and that in allocating additional power the principle be followed of giving the preference to applicants whose houses are adjacent to existing mains. The

following recommendation was also made by the Committee:—That in order to increase the supply from the town generating station, two additional boilers be obtained and erected at £2,000.

South African Society of Electrical Engineers.—Last month a meeting of this society was held at Johannesburg under the presidency of Mr. E. W. K. Peirce, who said that before the war there had been a society of the kind, and recently a movement which had resulted in that gathering, had sprung up for the resuscitation of the old body on modern lines.

Mr. G. Clark moved—"That the Association be again brought into active operation." Mr. O. B. Nicholetts seconded.

Mr. J. Norman Andrews moved—"That the old society be discontinued, and that negotiations be entered into for the establishment of a branch of the Home Institute." Mr. R. H. Covernton seconded.

Mr. L. B. Woodworth suggested that the society should be independent of any other associations, because of the cosmopolitan character of the profession in the town.

The chairman expressed the opinion that affiliation with large local kindred societies would mean a fuller and more instructive supply of papers than they themselves had time to compile, circulate and discuss. The amendment was lost, and the motion was carried.

Messrs. R. H. Covernton, C. E. Wilson, A. B. Nicholetts, W. H. Carlin, and J. H. Pickert were appointed a committee to assist the old Council in carrying out the resolution.

South African Telegraphs.—New telegraph offices have been opened at Upper Paarl, Cape Colony; Haenertsburg and Leydsdorp in the Transvaal. The offices at Balmoral, Cape Colony and Charter, Southern Rhodesia, have been closed; the former permanently, the latter temporarily. Telephone communication has been established with Macloutsie, Southern Rhodesia.

A NEW DESIGN FOR ELECTRIC TRAMCARS.

Designers of electric tramcars have long been engaged in attempting to produce a double-deck car in which passengers can ascend or descend the staircase with ease and safety without the platform being so cramped as to impede the actions or obscure the view of the driver or conductor.

New Type of Tramcar for Oldham.

In the old type direct staircases, in which the freedom of the driver is the first consideration, accidents to passengers are of frequent occurrence, owing to their being jerked off the staircase by a too sudden start or stoppage of the car. The now well-known reversed staircase was designed to secure the safety of passengers, but this is attained at the expense of obstructing the driver's view, and the various handles controlling the movements of the car. Another defect of the reversed staircase type of car is the necessarily long platform, which soon results in an undue hogging of the car body, and not only causes disfigurement of the car as a whole, but also sets up injurious strains which greatly diminish its life.

Mr. R. H. Wilkinson, general manager of the Oldham Tramways, has designed a car with a view to overcoming these disadvantages, and simultaneously securing the safety and comfort of the passengers. The means by which these improvements are effected is shown in the accompanying illustration. The staircase is of the direct type, and is let in the body of the car, so that the bottom of the stairs is flush with the entrance for inside passengers. The entrances to the staircases are provided with doors. We are informed that this arrangement of platform and entrances allows inside and outside passengers to get off or on without impeding each other's progress. The driver can see equally well on both sides, and has the whole platform at his disposal. The platform itself can be made shorter than in other types, and yet provide more room for passengers at the conductor's end and for the driver at the other end.

All these improvements are carried out at the expense of two inside seats only.

The total carrying capacity might, however, be increased, since the canopy could be extended and strengthened so as to provide additional top-deck seats, and at the same time serve as a better protection for the driver and conductor in inclement weather.

A car of this type is now in use on the Oldham Corporation's tramways, and has met with general admiration and approval.

REVIEWS.

Experiments with Vacuum Tubes. By Sir David L. Salomons, Bart., M.A. London: Whittaker & Co. 1903.

This little book describes some interesting and original experiments made by the author on the electrical discharge in vacuum tubes. The experiments chiefly relate to the formation of the well-known luminous bands produced in tubes of moderately high vacuum by the electric discharge. The author uses low electromotive forces in his experiments, thereby deviating from the methods of previous experimenters in this field, such as Spottiswoode and Moulton, who employed the highest E.M.Fs. obtainable from the largest induction coils. A number of new tubes are described by which bands at any required distance apart can be produced at will. The remarkable changes in the form and concentration of the bands produced by a powerful magnetic field are fully illustrated. The author states in his preface that he has made no attempt to propound a theory, but we find that he has not been able to adhere to this self-denying ordnance. We find such statements as these:—"The bright bands are due to heated matter and not to visible electricity." What does this mean to the modern electrician, who believes that matter, apart from its atomic electric charge, can communicate no vibrations to the ether?

Again, we read at p. 15, "it appears to me that the vacuum tube has a strong analogy to the ordinary metal conductor. The glass takes the place of the dielectric and the gas within represents the metal. *The current travels along the dielectric* and sinks into the gas." Surely this is a travesty of Poynting's theory, which merely states that the energy which maintains the current travels along the dielectric; nobody yet, we think, has been so bold as to maintain that a current prefers flowing through a non-conductor when it has the alternative of flowing through a good conductor.

We note that the *p* in the name of Prof. Silvanus Thompson's name has got transferred by some electrolytic process to the name of Prof. J. J. Thomson.

These experiments have engaged the attention of the author for many years; the many new phenomena he has demonstrated are extremely interesting, and most of them entirely inexplicable. The little book will be a valuable stimulus to research in this field.

Engine Tests and Boiler Efficiencies. By J. Buchetti. Westminster: Archibald Constable & Co., Ltd. 1903.

This is an excellent work on its subject, translated from the French by Alex. Russell, with a view to bringing Continental practice before the notice of English engineers. Indicators are first dealt with historically and to date, including various continuous indicators, of which Ashton and Storey's was the earliest, followed by Vernon Boys' and Lea's planimeter instrument. But we miss Ashton's later instrument and that of Little.

Diagrams are next discussed, and at Chapter VI. we find oil and gas engine testing, especially with reference to the indicator to be employed. Chapter VIII. is given to brakes, of which several forms are described and illustrated.

A very brief chapter on steam turbines appears to be interpolated as an after-thought, after which comes a chapter on steam, in which we find two methods of measuring priming; both of these are of doubtful utility, and remind us of a recent test of which we saw a report, in which priming was set down at 0·3 of 1 per cent.

No one has yet shown how to take a fair sample of steam to measure. One cannot measure steam wetness except with apparatus large enough to take all the steam made by a boiler.

Chapter XI. deals usefully with fuels, but contains the erroneous statement that "smoke once formed cannot be burned"—a statement contradicted seven lines lower down the page.

Only when we reach page 221 do we come to any reference to steam trials, with descriptions of the Orsat apparatus for gas analysis, and an appendix on chimneys and flues and other boiler matters. We should rather have named the book, The Indicator, the Brake, and Fuel Combustion, as its present title does not very well fit the book, which is by no means all about engine testing. It contains some useful information, and may be studied with advantage.

Steam Power Plants. By H. C. Meyer, Jun., M.E. New York: McGraw Publishing Co. 1903.

This volume is a reprint of some articles that appeared in the *Engineering Record*, to which some further subject matter has been added. The entire volume is devoted to American practice, and sectional drawings are given of several large American power stations, both for light and power purposes, but these are merely interspersed throughout the book, and not described in the text, nor are any tables of particulars even attached. The diagrams of the various stations are a great attraction when one first takes up the volume, but when one turns to the text in order to obtain more exact details as to size of plant, &c., one is distinctly disappointed to find that no particulars are given of these big power stations beyond the plans and sections.

Chapter I. is devoted to some general considerations, such as location of plant, type of power house, preparation of drawings, and so forth. Chapters II. and III. deal with boilers. On this subject the author goes into more detail, and treats his subject essentially from the practical rather than the theoretical standpoint. He quotes Barrus's well-known work on "Boiler Tests" as his authority for saying that where the proportions are suitable and the conditions favourable, "different types of boilers give substantially the same result." The various considerations determining the relative proportions of boilers are discussed, and standard specifications for the materials used in their construction are given, as well as specifications of the boilers themselves and their seatings.

Chapters IV. and V. are devoted to engines. The usual points, such as steam pressure, speed of rotation, piston speed, &c., are all discussed, rather from a practical engineer's or station engineer's point of view; the absence of abstruse or complicated formulæ is very noticeable throughout the book. Steam and water piping occupies the whole of Chapter VI. A useful table appears in this chapter in the shape of Brigg's table of standard pipes and flanges up to 10 in. diameter. For all pipe work, whether screwed or otherwise, the Americans have reduced their practice to standards far more than we have, and they have undoubtedly done this to their own advantage.

The lists of standard flanges adopted by the Master Steam and Hot Water Fitters' Association, and other similar bodies, are also given.

"Condensers" occupy Chapter VII., and in this chapter cooling towers are also dealt with. The difficulty of arriving at a satisfactory basis for a guarantee of condenser plant is discussed, but no very new ideas on this subject seem to be given.

The value of feed-water heaters and economisers is treated of in Chapter VIII.; the author states that for every 11° the feed-water is warmed there is a saving of 1 per cent. in the fuel burned, and some useful rough and ready figures are given as to the duty that may be safely expected from this kind of plant.

Chapters IX. and X. deal with mechanical draught and chimneys, and various sketches of recent American practice are given. Coal handling, water supply and purification occupy the last chapter.

The book is written for those who may be called upon without much previous training in this particular direction to purchase and superintend the erection of central station plant. The author says in the opening chapter that undoubtedly the best way is to employ the services of a qualified consulting engineer, but this is not always possible, and it appears to be much less the custom to do so in America than in this country. The book deals with a large subject from a practical, common-sense point of view, is well printed, and contains some useful information of recent American central station and power plant practice.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Oct. 21st, 1902.		Week ending Oct. 20th, 1903.	
Aden	Value £655	Adelaide	Value £39
Alexandria	143	Alexandria	161
Amsterdam	123	„ Teleg. mat.	168
Auckland	48	Amsterdam	70
Bombay	259	Calcutta	588
Buenos Ayres	78	Cape Town	1,181
Calcutta	363	Chinde	35
„ Teleg. wire	555	Delagoa Bay	220
Cape Town	629	„ Teleg. mat.	1,687
Coatzacoalcos. Teleg. apprts.	35	Durban	923
Colombo	130	„ Teleg. mat.	396
Copenhagen. Teleg. cable	120	Gibraltar	136
Demerara	50	Gisborne	24
Durban	146	Hong Kong	27
East London	284	Kobe. Cable	990
Fremantle	366	Lisbon	17
„ Teleg. mat.	96	Madras	147
Halifax	47	Melbourne	140
„ Teleg. mat.	72	Otago	119
Hong Kong	1,080	„ Elec. engines	1,352
Kobe	123	Penang	365
Madras	10	Perth	154
Malta	80	Rotterdam	21
Melbourne	89	„ Teleg. wire	45
New York	7	Shanghai	2,332
Otago	48	Singapore	436
Perth	783	Stockholm. Teleg. wire	160
Port Elizabeth	541	Sydney	1,919
Riga	20	„ Teleg. mat.	1,110
Rio de Janeiro	18	Tientsin	284
„ Teleg. mat.	75	Trinidad	18
Rosario	45	Wellington	1,200
Rotterdam. Teleg. mat.	130		
St. Petersburg. Teleg. mat.	390		
„ Teleg. wire	804		
Shanghai	37		
Singapore	59		
Sydney	469		
Vigo. Teleg. apparatus	750		
Wellington	56		
Yokohama	323		
Zanzibar. Teleg. mat.	60		
Total	£10,196	Total	£16,473

Foreign Goods Transhipped.

Gothenburg. Elec. appa.	Value £30	Gothenburg. Elec. appts.	Value £26
		Melbourne. Telephones	900
		Sydney. Elec. mat.	50
		Total	£976

Exports of British Electrical Machinery.—The value of the exports of British electrical machinery during September amounted to only £35,969, as compared with £37,046 in August last, bringing up the total for the first nine months of the year to £331,822.

A Glasgow Dinner.—Over 40 employés and friends of Messrs. Allan Arthur & Ure, electrical engineers, St. Vincent Street, Glasgow, sat down to dinner at the Lansdowne Restaurant on Friday evening last. Mr. A. Arthur presided. A smoking concert followed, and a very pleasant evening was spent with song and smoke, Mr. J. McNeillie presiding. This firm has on hand at present some important installation work, including about 600 lights for the offices of the Clyde Navigation Trustees; 250 lights for Nobel House, the offices of Messrs. Nobels Explosives Co.; and an installation for the Glasgow Academy, in Belmont Street.

Catalogues and Lists.—Messrs. Klinger & Co., of 66, Fenchurch Street, E.C., have issued a small booklet relating to their jointing material, "Klingerit," which is a specially prepared substance which will stand high steam pressures. Another pocket list shows and discusses the firm's patent water gauge.

List No. 154, issued by the British Thomson-Houston Co., describes their electrically operated draw-pit pumps; No. 153 shows several forms of their street pillars, with diagrams of connections.

A new illustrated list (October, 1903) has been brought out by Messrs. Hardy & Padmore, Ltd., of Worcester Foundry, Worcester, in which are detailed the "Southall" patent "Ideal" gas and oil engines. A tabulated list gives prices and various particulars of gas engines for from ½ H.P. to 8 H.P., and of oil engines for from ½ H.P. to 5½ H.P.

Messrs. Siemens Bros. & Co., Ltd., have lately brought out an excellently arranged catalogue of cable accessories and jointing materials. Some useful tables occupy the first few pages, and they show the legal standard wire gauge, comparative scale of thermometers, metrical weights and measures, sizes of conductors for wires, cables and mains. They are followed by art illustrations of a variety of cable appliances, tools, testing instruments, each alternate page containing clearly arranged prices of the different items. A loose leaflet gives data respecting the "C.M.A." flexible wire.

Mr. A. P. Lundberg, of Liverpool Road, N., has issued for the attention of the trade a very complete catalogue of his well-known accessories for electric lighting service. In some 44 pp. are given cuts, prices and descriptions of his many types of switches, wall connections, cut-outs, multiple distributors, ceiling roses, and many other accessories of the same class. We have no doubt that the catalogue will be in demand among members of the trade.

The British Westinghouse Co. has just issued a new circular, No. 1,045, on the protection of electrical circuits from the shocks due to lightning and other static discharges. The subject is illustrated by excellent photographs and diagrams. The various types of arresters, choke coils, &c., made by the company for high and low tension, alternating or direct current, are described, and a large amount of information, including practical instructions for installation, is included.

The North British Rubber Co., Ltd., of Castle Mills, Edinburgh, has issued a general mechanical price list detailing its sheet rubber, valves, mats, &c.

A leaflet of main switches, mounted on enamelled slates with teak or cast-iron cases, also main fuses, has been issued by the Birmingham Electrical Fittings Co., of Coleshill Street Electrical Works, Birmingham.

Books Received.—"Proceedings of the Incorporated Municipal Electrical Association, 1903 Meeting." Secretary, C. McArthur Butler, St. James's Hall, Piccadilly, W. 3s. 6d.

"The *Mechanical World* Pocket Diary and Year Book for 1904." Manchester: Emmott & Co., Ltd. 6d. net.

"Uber die Ferromagnetischen Eigenschaften von eisenfreien Manganlegierungen," by Fr. Hensler, W. Starck und E. Haupt. Brunswick: Friedrich Vieweg & Son, 1903.

"International Fire Prevention Congress, London, July 6th to 9th, 1903," including the Official Congress Report and an introduction by Edwin O. Sachs. London: *The Public Health Engineer*, 1903. 20s. net.

"The Dynamo," by C. C. Hawkins and F. Wallis. London: Whitaker & Co. 15s.

"Elementary Telegraphy and Telephony," by Arthur Crotch. London: E. & F. N. Spon, Ltd. 4s. 6d. net.

"Transactions of the Civil and Mechanical Engineers' Society, 1902-03." London: The Society.

"Tube, Train, Tram and Car, or Up-to-date Locomotion," by Arthur H. Beavan. London: Geo. Routledge & Sons, Ltd. 6s.

Trade Announcement.—Messrs. Gibbons Bros., Ltd., yesterday removed from 128, Palace Chambers, to more commodious offices at 142 and 143, Palace Chambers, Westminster, S.W.

Auction Sales.—On Friday, October 30th, Messrs. P. Huddleston & Co. will offer for sale at the Shillingford Engineering Works several loco. type boilers, engines, dynamos, pumps, &c., of which some particulars are given among our advertisements to-day.

On November 3rd, Messrs. Wheatley Kirk, Price & Co. will offer the works, plant and machinery, of Heaton & Smith, Ltd. (in liquidation). See our advertisements.

The Edwards Air Pump.—This patent air pump is being fitted to condensing plants for the following important electrical installations:—Aberdeen (repeat order), Bath, Bromley, Cork, Finchley, Gillingham, Gloucester, Glossop, Huddersfield, Ipswich, Leigh, Leicester, London Electric Supply Corporation, National Electric Supply Corporation (repeat order), Pietermaritzburg, South London Electric Supply Corporation (repeat order), Watford, Yorkshire Electric Power Co., Ltd.

Westinghouse Producer Gas Engines.—Messrs. Mander Bros., of Wolverhampton, have placed with the British Westinghouse Co., Ltd., an order for the supply and erection of a producer gas engine coupled to a 100-KW. electric generator. The engine will be of the Westinghouse three-cylinder vertical type.

Tramway Contracts.—Messrs. Edgar Allen & Co., Ltd., have secured from the Cheadle and Gatley Urban District Council, and from the Radcliffe Urban District Council, contracts for the supply of points and crossings, with tongues and renewable centres in Allen's Imperial manganese steel.

Batley Tramways.—Westinghouse magnetic brakes will be used on the new cars now being built by the British Electric Car Co., the equipments having been recently ordered from the British Westinghouse Co.

Electrical Vehicles.—La Compagnie des Voitures Electriques Krieger, of Paris, has lately completed an electrical victoria for the Queen of Italy. There are two electric motors, one connected to each of the front wheels. The current is supplied by a battery of Fulmen accumulators of 250 ampere-hour capacity, sufficient, it is stated, for a run of over 50 miles on one charge.

Imports of Foreign Electrical Machinery.—The value of the foreign electrical machinery imported into this country during last month amounted to £38,481, as compared with £33,791 in August last, bringing up the total for the first nine months of the year to £430,018.

Engineering Firms and Motor-Car Construction.—We recently mentioned that Messrs. Willans & Robinson, Ltd., were taking up the construction of motor-car components. We now hear that another firm of high-speed engine builders—Messrs. Peter Brotherhood—are moving in the same direction, and that both Messrs. Crossley Bros., Ltd., and the National Gas Engine Co. are taking up the construction of petrol engines.

Liquidation.—At a meeting of the Yorkshire Electric Power Syndicate held at Leeds on September 29th, it was resolved to wind up voluntarily.

Bankruptcy Proceedings.—On October 15th a meeting of the creditors of Thos. Williams, electrical engineer, of 54, Bridge Street, Llandaff, and late of 13, Despenser Street, Cardiff, was held. The accounts showed gross liabilities, £13,019; unsecured liabilities, £1,653; assets, £1,914; estimated surplus, £261. The creditors appointed the Official Receiver as trustee.

Destructors at Nottingham.—On Saturday the members of the Association of Cleansing Superintendents of Great Britain visited Nottingham and inspected the destructors which are used on the various Corporation sites. Nottingham was one of the first English towns to adopt destructors. In 1882 five cells were erected at the Eastcroft. Messrs. Manlove, Alliott & Co., of Nottingham, are now erecting a new destructor at Radford, a western suburb, this consisting of 12 cells placed in a row. Electricity for tramway traction is generated through the agency of the destructor boilers. The party visited Messrs. Manlove, Alliott's works.

ELECTRIC LIGHT AND POWER NOTES.

Aldrington.—A L.G.B. inquiry was held on 15th inst. into the T.C.'s application to borrow £15,000 for electric lighting purposes. An order was obtained in 1898, but, in consequence of the tramway scheme, it was not immediately proceeded with. It is proposed to take energy in bulk from either the Hove E.L. Co. or the Brighton Corporation; offers from both were before the Council.

Antony.—The P.C. has received a communication from the Devonport Corporation, agreeing to consider any proposal for the supply of electricity for lighting the town when the Council has obtained the necessary powers to supply it.

Arbroath.—The E.L. Committee of the T.C. has asked a number of private companies as to their terms for introducing electric light into the burgh.

Barry.—The D.C. has decided to apply to the B. of T. for an extension of its electric lighting prov. order.

Bexley.—The U.D.C. has recently fixed the price of energy for motive power at 2d. per unit, provided consumers agree to cut off their motors between 5 p.m. and midnight.

Bideford.—The Southern Electric Supply Co. has stated its terms for applying for a prov. order for supplying the town with electric light, and the U.D.C. has decided not to accept them.

Brentwood.—The U.D.C. has appointed a committee to ascertain whether the Sir Hiram Maxim Electrical and Engineering Co. would be prepared to lease the prov. order if one is obtained.

Bridlington.—A L.G.B. inquiry was held on 15th inst. into the application of the Council to borrow £26,500 for electric lighting purposes. No opposition was offered.

Bridport.—The Southern District Electricity Corporation has given notice that it intends to apply to the B. of T. for a prov. order to supply electricity within the borough.

Brighton.—The following scale of charges for the supply of energy to outside authorities has been adopted by the T.C.:—First year, 7d. per unit for the first 200 hours' use in each half-year, and 1d. per unit for the balance. For subsequent periods the price is to be fixed by agreement.

Bury.—The T.C. has accepted the offer of the B.T.H. Co. for the supply of motors on the hire system for a year.

Carlisle.—The T.C. has declined to reduce the minimum consumption of units by the Tramway Co. from 350,000 to 300,000 per annum. The uniform price is 1·6d. per unit.

Canterbury.—The L.G.B. has given permission for the T.C. to borrow a loan of £4,000 for electric lighting. The Council took up a loan in 1901, but in excess of that it has spent £2,383 in connecting up mains, &c., and in purchases, &c. It, therefore, requires to borrow that sum to cover the amount already expended and for further contingencies.

Carnarvon.—The T.C. has sanctioned the appointment of an expert to decide upon the respective merits of the schemes of the National Wiring Co. and the North Wales Power and Traction Co.

Clitheroe.—The T.C. has appointed a sub-committee to consult its expert, Mr. Thomas Barton, of Blackburn, in regard to the lighting of the town by electricity.

Croydon.—Last week Major Stuart, L.G.B. Inspector, inquired into the application of the B.C. for power to borrow £29,975 for the purpose of extensions at the electricity works. Mr. J. Gray Scott, borough electrical engineer, stated that the demand for energy was rapidly increasing, and they only had sufficient plant to cope with present requirements. The present capacity of the generating station was 4,165 KW., of which 1,360 KW. was for tramways, 600 KW. direct current for lighting, and the balance, 2,205 KW., was available for the alternating current supply. It was proposed to put in a new 750-KW. generating set, and build a new engine and boiler house, with a 200 ft. chimney. The details having been fully explained, the Inspector paid a visit to the generating station.

Darlington.—The Corporation has fixed 1¾d. per unit as the charge for current supplied to the electric tramways.

Dorchester.—Last week the T.C. resolved to apply for sanction to borrow £16,000 for the carrying out of its electric lighting order, and adopted the scheme for lighting the compulsory area as prepared by Messrs. J. and J. S. Enright.

East Molesey.—The D.C. has received a communication from Messrs. Pressland & Frippard, electrical engineers, Westminster, offering, on behalf of Edmundson's Electric Light Corporation, certain modifications in the prov. order. After discussion the terms were accepted provided that if at any future time better terms were given to any place within a radius of 20 miles, Molesey should receive the same consideration.

Elland.—The Council's electric lighting installation was inaugurated last week in conjunction with its refuse destructor. The whole of the work has been carried out to the plans of Mr. Walter Emmott, of Halifax, consulting engineer to the Council. The opening ceremony was presided over by Mr. W. H. Eastwood, J.P., chairman of the D.C., and the machinery was started by Mr. S. Dyson, chairman of the Electricity Committee, Miss Dyson switching the current on to the town. It was stated that the dynamos were designed for a traction load, so that there would be no further expense as regards the generating station if it was decided to lay down a tramway system. The switchboard also was designed to deal with a traction load. The installation comprises Belliss & Morcom engines; dynamos by Messrs. Greenwood and Batley; and condensers by Messrs. Thornton & Crebbin; the cables were supplied by the Anchor Cable Co.; switchboard by Messrs. Hodgson Wright & Wood; and a battery by Messrs. Ashmore, Benson, Pease & Co.

Gillingham (Kent).—The D.C. has decided to apply to the L.G.B. for leave to borrow a further £20,000 for electric lighting purposes. The Council since purchasing the undertaking has been laying down mains extensively in the district.

Gloucester.—The Corporation is arranging to hold an electrical exhibition, at the Guildhall, from November 18th to 21st (Wednesday to Saturday). Full particulars of the available stands, their location and cost, have been drawn up, and those firms who are disposed to exhibit can obtain copies of the document giving this information upon application to the Corporation's electrical engineer, Mr. Bache.

Grantham.— The electricity works were opened last week, when the Mayor, Mr. Wm. Hornsby, J.P., switched on the current in the presence of a large gathering. He was presented with a silver switch as a memento of the occasion.

Italy.—La Società Electrica Vigezzina is a company which has been formed to put down plant to utilise certain available water power in the Vigezzi Valley for the generation of electrical energy for lighting and power purposes in the surrounding district. The contract for the necessary plant has been placed with Messrs. Gadda, Brioschi Finzi & Co., of Milan.

Leadgate.—The U.D.C. has received a communication from the Northern Counties Electric Supply Co., intimating that they would be prepared to make arrangements for lighting the district, including Crookhall, with electricity by 1904-5. The letter evoked much satisfaction.

Linthwaite.—A agreement has been completed between the U.D.C. and the Huddersfield Corporation for the supply of electricity to the district.

Leigh.—The electrical engineer has recommended the T.C. to expend £10,780 in extensions, as the present generating plant will be fully employed during the coming winter. The following is a summary of the extensions proposed:—

Extensions for 1904: 350-KW. generating set, piping, foundations, &c...	£3,500	0	0		
Switchboard for same	300	0	0		
				£3,800	0 0
Extensions for 1905: One water-tube boiler, piping and foundations complete	1,500	0	0		
Mains, services, &c., 1904-5 (estimated)	2,000	0	0		
Motors (repayment of existing loan or further borrowing powers)	2,500	0	0		
				6,000	0 0
Contingencies, 10 per cent.				980	0 0
				£10,780	0 0

The report was referred to a sub-committee for consideration.

London.—POPLAR.—The Electricity Committee reports that the proof statement of the accounts of the undertaking to March 31st last shows that after meeting the deficiency of £382 11s. 2d. at the commencement of the year, there remained a balance of £3,902 3s. 4d. to be carried forward to the next account.

HORNSEY.—The D.C. has decided to obtain two 300-KW. steam dynamos for extensions.

WESTMINSTER.—The General Purposes Committee has had under consideration the question of the various charges made by electric companies in the district; also an application by the Charing Cross and Strand Electricity Supply Corporation for consent to the transmission of energy up to 2,000 KW. in certain trunk mains. The Committee had no objection to the granting of the application, but was of opinion that local governing bodies should be furnished with further powers in order to exercise greater control over the breaking up of the streets; also that a condition should be inserted in all orders making it obligatory upon electric supply companies to supply light and power to public buildings, or for public lighting, at rates not greater than the lowest rates charged to any of their consumers.

HACKNEY.—The Electricity Committee of the B.C. reported recently that after negotiating for some months with the Great Eastern Railway Co. to light their stations in the borough, it had been agreed, subject to the Council's confirmation, to supply energy at 8d. per unit for the first 100 units per KW. MAX. demand per quarter, and 2d. per unit afterwards.

LAMBETH.—Two memorials having been received from the ratepayers calling attention to the emission of "blacks" and smoke from the works of the South London Electric Supply Corporation, Ltd., the B.C. has resolved to undertake a prosecution.

ISLINGTON.—The B.C. has adopted the recommendations of the Lighting Committee (reported in last week's issue) to reduce the charges for light and power, and to extend the mains at an estimated cost of £1,900.

CHELSEA.—On Wednesday last the B.C. resolved to join with other metropolitan local governing bodies in making representations to the Royal Commission on London Traffic with reference to the great inconvenience caused by the blocking and opening up of roads by electric lighting and other public companies in pursuance of their statutory powers, and in urging the Commission to recommend Parliament to limit the powers of such companies so that they be empowered to open up the roads at such times only as the roads can be surrendered to them without great inconvenience to the ratepayers.

SOUTHWARK.—In order to encourage the costers who have been displaced from the main roads of the borough, the B.C. proposes to light the side streets into which they have been removed, with arc lamps.

FINSBURY.—The Works Committee of the B.C. has brought up a comparison of the present system of lighting with incandescent gas, and an offer made by the County of London and Brush Provincial Electric Lighting Co. As an instance, Pentonville Road, City Road, Finsbury Square (west side), Finsbury Pavement, Old Street, Clerkenwell Road, and Golden Lane (total length 3 miles 158 yds.) were taken. With the present 252 incandescent gas lamps, the cost was £986 15s. 3d. With 100 electric arc lamps (capital expenditure for columns, &c., £3,500), and allowing for repayment of loan of £3,500, spread over 20 years, and deducting the £986 present cost, the cost would mean an increased annual expenditure of £1,549.

LAW COURTS.—Considerable additions and improvements have been effected during the Long Vacation, and now every Court is fitted with two new electroliers each containing 10 lights; lamps have been placed over the jury and witness boxes, and the public galleries are supplied with two lights each.

BATTERSEA.—It was agreed at the B.C. meeting last week to alter the charges for electrical energy for motive power at the expiration of the current quarter, from 2d. per unit with rebates to 1½d. per unit without rebates.

MARYLEBONE.—The L.G.B. has informed the B.C. that it must uphold the refusal of the County Council to sanction the borrowing of £1,274,000 for the purchase of a portion of the undertaking of the Metropolitan Electric Supply Co. It is understood that the B.C. will call a special meeting to sanction the promotion of a Bill in the ensuing session to empower the Council to borrow the necessary money to purchase the undertaking.

Lowestoft.—The L.G.B. has forwarded to the T.C. sanction to raise a new loan of £2,000 for electric lighting purposes, half being for the purchase of cables, and the balance for meters, indicators, &c.

Newport.—The E.L. Committee decided some months ago to light a portion of the town with incandescent electric lamps, but has now resolved to instal Nernst lamps instead.

The electrical engineer has been instructed to put up some enclosed arc lamps of various patterns for inspection, and to prepare a report upon them. The Committee will then decide the pattern to be adopted for the proposed extension of the borough public lighting system.

The Brush Electrical Engineering Co. has made the Corporation an offer with respect to the supply of motors to power consumers in the town, and the electrical engineer has been instructed to investigate and report.

Newry.—The D.C. is understood to have had a proposal from a Westminster firm, acting on behalf of a syndicate, notifying their intention to apply for Parliamentary powers for a lighting and power scheme in the North of Ireland. It is stated that they intend to erect generating stations in the manufacturing portions of the counties of Down, Antrim, Armagh and Londonderry. The area of the district it is proposed to cover is 1,600 sq. miles.

Penmaenmawr.—The U.D.C. has decided to engage Messrs. Cruse & Hancock to prepare a report in connection with the proposed electric lighting of the district.

Plymouth.—The T.C. has decided to have the electric light installed in the Borough asylum, at a cost of from £2,450 to £2,550. It is estimated that the annual saving over gas will be from £180 to £190 a year.

Portsmouth.—The Corporation Electricity Committee has decided to appeal against the assessment of the electricity works being increased from £2,900 to £4,320. Although the capital of the undertaking has only been increased by 25 per cent. since 1901, the assessment has been increased by 50 per cent.

Ramsgate.—The T.C. on October 15th decided to accept the offer of Edmundson's Corporation for the leasing of the Council's prov. order for electric lighting.

Reigate.—A L.G.B. inquiry has been held into an application by the T.C. for sanction to borrow £8,165 for the purpose of extending the electric light works. When these extensions are completed it is estimated that the output will be greatly increased, and in two years' time will result in a profit of £1,000 a year.

Rutherglen.—In reference to an application by the T.C. for a supply of electrical energy within the burgh, the Glasgow Corporation Electricity Committee has arranged that, if the T.C. are prepared to apply to the B. of T. for a prov. order containing clauses repealing the powers of the Clyde Valley Electric Power Co. to supply electrical energy within the burgh, in competition with the T.C. or its assignees, and empowering the Rutherglen T.C. to transfer the order so obtained to the Glasgow Corporation, the Corporation would agree to take over the order.

Southport.—The Corporation Electricity Committee has decided that in future no electric light fittings shall be supplied on the hire-purchase system.

St. Austell.—On the 19th inst. the St. Austell electric works stopped working during the day, and will finally close during the month. Considerable consternation has been caused by the announcement, as a large number of shops and public meeting places have been fitted for electric light and motive power during the past few years.

Spain.—A concession has been granted for the establishment and working of a generating station for electric lighting in the town of Mansilla de las Mulas (Leon Province).

Stourbridge.—At a meeting held last week the Council accepted the scheme of Mr. J. B. Clark for lighting the town by electricity. The generating station will be in combination with the refuse destructor, and it was resolved to apply to the L.G.B. to sanction a loan of £16,000. Mr. Clark was appointed engineer.

Stretford.—It is stated that the formal opening of the new generating station at Longford Bridge will take place in the course of the next week or so.

Swinton and Pendlebury.—The B. of T. has intimated that it will defer the question of revoking the U.D.C.'s prov. order for electric lighting, obtained in 1899, for one year from October 15th, 1903.

Teddington.—The D.C. has received from the B. of T. descriptions of the systems proposed to be adopted by the Twickenham and Teddington Electric Supply Co., Ltd., for the supply of energy under the Teddington Electric Lighting Order, 1901, and the form in which the Board propose to approve them subject to regulation. The Council has approved the form of order and regulations proposed.

Thornaby.—The T.C. on 13th inst. considered an application from the Sir Hiram Maxim Electrical and Engineering Co. offering to take over their prov. order for lighting the town by electricity, and the matter was referred to the General Purposes Committee.

Wisbech.—The T.C. has resolved to obtain advice as to the lighting of the town by electricity.

Tiverton.—The T.C. has decided to accept, subject to the B. of T. and the L.G.B., the tender of Messrs. Frank Suter Co. to instal electric light for £9,990, and for an additional £500 to work the undertaking for three years, the firm being responsible for the maintenance, sinking fund, and interest, but taking all the receipts earned. It was also decided that the maximum price to private consumers be fixed at 6d. A complaint was made that another firm's offer was declined because they were foreigners. The borough surveyor stated that Messrs. Suter promised to use all materials of British manufacture, except the dynamos, which were to be of the Helios Co.'s make.

Tunstall.—The U.D.C. is in communication with Messrs. Baker, Lees & Co. relative to the establishment of E.L. works under the Council's prov. order of 1890, by a company. A copy of the company's proposals is to be submitted to the members of the Council for consideration.

Walton.—The U.D.C. has just sealed an agreement with the Urban Electric Supply Co., Ltd., for installing the electric light in the town.

West Bromwich.—A L.G.B. inquiry has been held respecting an application by the T.C. to borrow £12,217 for the purposes of the electric light undertaking. The application was made in consequence of the necessity for an extension of the works, arising from the largely-increased demand for electricity, chiefly for tramway purposes. No objection was offered to the application.

Whitehead (Co. Antrim).—A company has been formed to carry on the electric lighting undertaking in this town.

Whitley Upper.—The U.D.C. has resolved to ascertain from the Yorkshire Electric Power Co. the cost of supplying energy for lighting purposes from the generating station at Thornhill.

York.—The L.G.B. has sanctioned a loan of £10,850 for extensions at the generating station and electric lighting purposes generally.

ELECTRIC TRACTION NOTES.

Aberdeen.—The tramway to Torry, the most recent extension of the Aberdeen Corporation system, was formally declared opened on the 10th inst. A cake and wine banquet was held afterwards at the Douglas Hotel. The line (a single track) is about 1½ miles long.

Chatham.—The Chatham and District Light Railway Co. are about to lay down a double line of tramways from Chatham to Gillingham, by way of Chatham Hill and the Rainham Road. This will mean an extra expenditure of some £5,000 or £6,000. The company are pushing their improvements in the services at Old Brompton, in order to open up a through and unbroken connection between Brompton and Chatham lines.

Douglas (Isle of Man).—The Tramways Committee has decided to reduce the hours of the tramways employés to about 60 per week. In the past the hours of work have numbered about 70. The car service will remain as it has been, but four additional men will be employed. The profit on the working of the tramways for the year, up to August, was £653 in excess of the corresponding period last year.

New York.—The *Electrical World and Engineer* states that the New York Rapid Transit Subway Commissioners have purchased an additional lot, 108 × 200 ft., on which to erect an addition to the subway power house now building on the Hudson River. The addition will make the plant the largest and most expensive in the world. It will cost altogether $7,000,000, and will be capable of generating 132,000 H.P. The boiler plant at first will consist of 72 boilers, each of 500 H.P. The coal will be carried by belt conveyors to a storehouse 80 ft. above the ground, with a capacity of 25,000 tons. The ashes from the boilers will be carried by cars to scows lying in the river. There are five brick chimneys of unusual construction, in that their bases will rest on steel platforms about 40 ft. above the floor of the power house, as building the stacks from the ground up would have occupied a great deal of valuable space in the middle of the building. The chimneys will reach a height of 265 ft.

France.—Owing to difficulties with steam traction on the railway from St. Georges de Commiers to La Mure in connection with the anthracite mines at the latter place, the French State Railway authorities decided some time ago to adopt electric traction on the most difficult section—that between La Motte-les-Bains and La Motte d'Aveillans, which comprises many grades of from 25 to 27½ per cent., and many sharp curves. As a result of negotiations an order for an experimental electric locomotive, to work on the overhead system, and to be capable of hauling 20 wagons loaded with a total of a 100 tons of coal at a speed of 13½ to 14½ miles per hour, was placed with the Compagnie de l'Industrie Electrique et Mecanique (Thury), of Geneva, Switzerland. The locomotive weighs 50 tons, and is 43 ft. long between the buffers. The system is high tension continuous, three-wire, 2,400 volts, there being two overhead lines, the rails forming the third wire. The engine is equipped with four 125-H.P. motors, taking 185 amperes at a speed of 400 revolutions per minute. The engine

is fitted with operating gear at both ends, and in the trials to which it was submitted, successfully hauled a train of 24 wagons loaded with 120 tons of coal.

Great Northern and City Railway.—It is stated that a moving staircase is to be introduced at the Lothbury station of the Great Northern and City Railway, to carry passengers to and from the surface.

Huddersfield.—From a financial statement for the six months ending September 30th, it appears that the capital outlay of the tramways undertaking is £410,953. During the six months 834,160 miles have been run, compared with 626,031 last year. The receipts amount to £34,672 13s., or 9·97d. per car-mile, as against 11·00 last year. The working expenditure amounts to £18,425, or 5·30d. per car-mile, compared with 5·54d. last year, leaving a gross surplus of £16,248, or 4·67d. per car-mile, as against 5·46d. Interest on the debt absorbs £7,772, and the redemption of debt amounts to £5,561, giving a surplus of £2,914, or ·83d. per car-mile, as against 1·31d. last year. No provision is made in this statement for depreciation.

Italy.—Cômo and Milan, which are situated 30 kilometres apart, are to be connected by electric traction. The Lampo system is to be used, and a speed of 120 kilometres per hour is anticipated.

Liége.—The Liége-Seraing Railway Co. has decided to adopt electric traction, and in view of the forthcoming exhibition in 1905, the line is to be extended in and about Liége.

Liverpool.—In responding to a vote of thanks for his services as chairman of the Corporation Tramways Committee during the past municipal year, Sir Charles Petrie, at the final meeting of the committee on Friday last, referred to the progress of the tramways undertaking. In the first nine months of 1897 the tramways carried 29,000,000 passengers. In the nine months of the present year they had carried 64,000,000 an increase of 192 per cent. The mileage in 1897 was 4,469,734, and in 1903 8,713,230, an increase of 94 per cent. The receipts in 1897 were £219,766, and in 1903 £393,411, an increase of 79 per cent. If the electric cars had been introduced into Liverpool 10 years before they were, some of the suburbs, Sir Charles said, would now be more thickly populated than they are. The abnormal weather had prevented a much higher increase in passengers and receipts. In May last an arrangement was made with the South Lancashire Tramways Co. for a through running of their cars between St. Helen's and the Pierhead, and the company thought the committee had made too good a bargain in the matter, and one that was not quite beneficial to them. The arrangement would, however, continue to the end of the present year. The service of cars in the city had been improved by reducing the number of cars in operation during the quiet hours of the day and increasing them during the period of maximum demand. The question of extending the tramways bayond the city boundaries in one or two directions had been under notice. The matter would be brought further under the notice of the committee at an early date. Sir Charles, in closing, paid a warm tribute to the general manager and his staff.

London.—The L.C.C. has withdrawn its electric cars from the Kennington to Streatham Village cable route. It has been found that the electric cars, although smaller than the ones running over the Tooting lines, cause too great a strain on the cable, and do not run as smoothly as could be desired; consequently they have been replaced by the old cars until the line can be electrified. The cable cars only run from Streatham to Kennington, and do not continue the journey to the termini at the bridges by means of horse traction as formerly, so that passengers who desire to go on have now to change at Kennington into electric cars. Special tickets are provided to effect the change.

Hackney.—The General Purposes Committee of the B.C. has decided in favour of informing the L.C.C. that any scheme for the adoption of the overhead trolley system for the working of tramways within the borough will be strenuously opposed.

Manchester and Ashton-under-Lyne.—Last week witnessed the withdrawal of the last of the horse cars of the Manchester Carriage Co. Those displaced last week in Ashton, which had been running between the Ashton market place and the terminus of the Manchester tramway system, at Audenshaw, were the last survivors. The Manchester Tramways Committee have just completed the reconstruction and equipment of the Ashton lines, acting as contractors to the Corporation of that borough, and cars are now running daily, at frequent intervals, between Manchester and Ashton-under-Lyne. For the present, passengers are required to change into the Ashton Corporation cars at the borough boundary, but shortly, under an agreement which, it is understood, has been arranged, Manchester cars will run through, over the new lines, to the Ashton market place. These lines have also a connection with Stalybridge.

Musselburgh.—At the last T.C. meeting it was reported that the estimates in connection with the electric tramways had almost all been got in, and the National Electric Wiring and Construction Co. expect to commence operations this month. The tramway line will extend from Magdalene Bridge, Musselburgh, to Levenhall, a distance of nearly three miles, mainly double track.

Newcastle-upon-Tyne.—At the meeting of the City Council on the 14th inst., Mr. Cail presented a report from the Tramways Committee recommending that application should be made to Parliament for power to construct certain additional tramways. The city engineer's estimate for construction was £133,850, and the general manager's estimate for electrical equipment was £156,476, a total estimated cost of £290,326; this included generating plant and sub-stations £65,000, and £30,000 for additional cars. In moving the report Mr. Cail referred to the great financial success of the trams, and said the Committee aimed at something even higher and of more advantage to the people of the city. They were now carrying some 43,000,000 of people in a year, and they found that whenever there was an extension the rate of receipts per car-mile went up. Mr. Murray seconded, and after a brief discussion, the report was agreed to, an addition being made to the fifth route, that a line should be laid down Chillingham Road to be connected with Heaton Road. With this amendment the report was carried.

Nuremberg.—The Continentale Gesellschaft für Electrische Unternehmungen has received a concession for the construction of a railway similar to the Barmen—Elberfeld line. The line will be 21 km. long and it is estimated will take five years to complete and cost 44 million francs.

Pietermaritzburg.—The British Westinghouse Co. are supplying for the new tramway system here six complete electric tramcar equipments. These will be of standard Westinghouse pattern, each including two No. 90 series-parallel controllers, two No. 200 (35 H.P.) motors, and all the usual auxiliary apparatus, including automatic cut-out, lightning arresters, &c.

Southend.—At the Board of Trade, Whitehall Gardens, Sir Herbert Jekyll, Assistant Secretary of the Railway Department, sat on Thursday last week to hear objections to the confirmation of the Southend-on-Sea and District Light Railways (Extension) Order. The scheme is promoted by the Corporation for the extension of the present light railway system, the principal extension being as far as Shoeburyness, so as to give means of communication by the light railway system between Southend and that place. The only opponent was one Col. Burges, who is a large landowner, through whose property it is proposed to construct part of the extension. He objected tha the proposed line of route would interfere with the development of his land as a building estate, that it would depreciate his property, and that there was no need for such a light railway between Southend and Shoeburyness. He urged that instead of the Corporation going through his land, which is on the high level, it should adopt another route, which would be under the cliff and nearer to the sea front. The cost of that would be less, and the public would get a nice promenade, which in time could be made to join the existing promenade at Southend.

South Shields.—A meeting of the Tramways Sub-Committee was held on the 13th inst. to consider the mode of traction, routes, &c. It is stated on the very best authority that the Committee decided to recommend the adoption of the overhead trolley system of electric tramways. As to the routes, it was propcsed to make a curtailment of route No. 1, and to cut out entirely that portion of the route from the top of Green Street to the present terminus in the Corstorphine Town and Tyne Dock section. In lieu of this there will be a new system of lines through Frederick Street, South Frederick Street, Gilbert Street, South Eldon Street, St. Mary's Terrace, and Dean Road to Slake Terrace. It is estimated that the elision of the Corstorphine Town section will reduce the total cost by about £20,000. It was decided to advertise for tenders for the leasing of the tramways.

Stretford.—The U.D.C. has been informed of the decision of the Light Railway Commissioners upon the various schemes submitted to them for the construction of lines in Stretford. The Council and the West Manchester Light Railway Co. presented conflicting plans, and the Commissioners have struck a balance by sanctioning portions only of both.

Torquay.—It is announced that the Dolter Electric Traction Co. intend to instal their surface contact system of tramways here.

Woking.—The U.D.C. has given a qualified approval to the amended scheme of trams for Woking, as set out in a letter addressed to the Council by the engineer (Mr. G. T. Harrup).

TELEGRAPH AND TELEPHONE NOTES.

London Telephones.—The Post Office Telephone Department arranged to open the new Mayfair exchange on Tuesday last. The exchange will serve an area bounded by Regent's Park on the north, Knightsbridge and Pall Mall on the south, Regent Street on the east, and Bayswater on the west.

Wireless Telegraphy.—The Admiralty have given instructions for a wireless telegraphy station to be established at Felixstowe, which has been made the new base port for the Medway Destroyer Instructional Flotilla. The installation is to be

carried out to the superintendence of the dockyard authorities at Sheerness, who have just completed the laying of 14 sets of moorings at Felixstowe for torpedo-boat destroyers.

The *Daily Telegraph* says that after being in constant communication with the shore or passing ships throughout her voyage from Liverpool, the Cunard liner *Umbria* arrived at the other side on 19th inst. One message received came from her eastward-bound consort *Etruria*, which was passed in mid-ocean. The message read: "Had clear weather; saw no ice; all well." This the *Daily Telegraph* points out conflicts with the cable report from Liverpool that the *Etruria* hit a cumulative wave, several passengers being injured.

The *Standard* Berlin correspondent says that the Military School of Electricity in St. Petersburg has been actively engaged, for some time past in experiments with wireless telegraphy on the Slaby-Arco system. The distance covered at the latest trial extended over 130 versts from St. Petersburg to Narva. Kites flown at high altitudes are used as receivers. The wires at the permanent receiving station of Narva are fixed on a church and on the old Hermann Tower, at a height of about 150 ft. The proportion of successful messages is said to have been seventeen out of nineteen.

It is stated that Mr. Marconi has accepted an invitation from the Admiralty to give on board a battleship an illustration of the success of his work in the transmission of messages to ships by wireless telegraphy over long distances. For this purpose Mr. Marconi has arranged to embark on H.M.S. *Duncan*, which is to leave Portsmouth for Gibraltar in the course of a day or two.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara No. 1	Aug. 27, 1901	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Guadeloupe-Martinique	May 7, 1902	
Puerto Plata-Martinique	July 10, 1902	Oct. 19, 1903
Cayenne-Pinheiro	Aug. 13, 1902	
St. Lucia-St. Vincent	Sept. 19, 1902	
Reissa-Issa (Yemen)-Camaran	Oct. 22, 1902	
Paramaribo-Cayenne	Feb. 27, 1903	
New York-Haiti	April 13, 1903	
Nagasaki-Fusan	Oct. 19, 1903	
Landlines		
Communication with Puerto-Barrios	July 28, 1903	
Moulmein-Bangkok	Oct. 17, 1903	Oct. 19, 1903

CONTRACTS OPEN AND CLOSED.

OPEN.

Beckenham.—November 9th. Electric wiring under free wiring scheme. See "Official Notices" October 16th.

Blackpool.—November 14th. One 450-KW. traction set (vertical triple-expansion engine and multipolar generator). See "Official Notices" to-day.

Chorley.—The Corporation invites offers for its electric lighting order. See "Official Notices" to-day.

Devonport.—October 24th. Motor-driven booster for the electricity department. See "Official Notices" October 16th.

Johannesburg.—November 16th. Gas producer plant; gas engines and dynamos. Alternative:—Water-tube boilers, steam engines or turbines, electric generators, and other plant. For the municipal tramways and electrical supply scheme. See "Official Notices" August 28th.

Kilmarnock.—November 18th. Lancashire boilers; engines and dynamos; crane; battery; and switchboard for electricity scheme. See "Official Notices" October 9th.

Leeds.—November 13th. Forty-five tons of piping and valves for the electricity works. See "Official Notices" to-day.

London.—November 3rd. Engine, dynamo, wiring, &c., for an installation at the Abbey Mills Pumping Station at West Ham, for the L.C.C. See "Official Notices" October 2nd.

Newport (Mon.).—October 24th. Triple and concentric paper cable. See "Official Notices" October 16th.

Radcliffe.—November 14th. Lighting and traction switchboards and accessories; rail bonds for the U.D.C. See "Official Notices" to-day.

Spain.—October 26th. The Municipal Authorities of Munera (province of Albacete) are inviting tenders until the 26th inst. for the concession for the electric lighting of the town during a period of 20 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Munera (Albacete).

Spain.—Tenders are at present being invited by the municipal authorities of Fuensanta (Province of Jaen), for the concession for the electric lighting of the town during a period of 19 years. Tenders are to be sent to El Secretario del Ayuntamiento de Fuensanta (Jaen), whence particulars may be obtained.

Swansea.—October 31st. Permanent way, rails, special work, overhead equipment, cables, ducts, &c., for tramways. See "Official Notices" September 25th.

Swansea.—October 31st. Ducts, troughs, cables, wires, street boxes, &c. See "Official Notices" September 25th.

Todmorden.—October 31st. Lancashire boiler; steam dynamos, pumps, switchboard, battery, cables, crane, &c., for electricity supply. See "Official Notices" October 9th.

Wednesbury.—November 20th. Electric wiring of public buildings. See "Official Notices" to-day.

CLOSED.

Boston.—The following tenders have been received by the T.C. for installing the electric light in the new municipal buildings:—

J. Bakewell & Co., Peterborough	(Accepted)	£474
W. J. Furse & Co., Nottingham		494
Cox-Walkers, Darlington		534
Beaven & Sons, Gloucester		560
Beaumont & Co., York		576

Doncaster.—The Board of Guardians last week decided to advertise for tenders for 125 storage cells and outside standard lamps.

France.—The French Post and Telegraph authorities in Paris have just given out contracts as follows:—La Compagnie Francaise des Metaux, of Paris, 100 tons of high conductivity copper, 2½ mm. diameter, at 1,930 fr. per ton; La Compagnie Générale d'Electricité, of Paris, 100 tons ditto, at 1,929 fr. per ton; M. Grammont, of Pont de Cheruy, 50 tons ditto, at 1,928 fr. per ton; La Compagnie Francaise du Bimetal, Paris, 50 tons ditto, at 1,924 fr. per ton; La Société des Mines de Pontgibaud, of Paris, 50 tons ditto, at 1,882½ fr. per ton, and 100 tons ditto, 3 mm. diameter, at 1,918 fr.; Les Trefileries du Havre, 50 tons ditto, at 1,924½ fr.; Le Forges de Franche-Comté, Besancon, 50 tons ditto, at 1,924 fr., and La Société d'Electro-Metallurgie de Dives, 50 tons ditto, at 1,925 fr. per ton.

Fulham.—The Council has accepted the tender of Messrs. Locket & Judkins for a supply of 1,000 tons of Welsh coal (No. 1 Locket steam navigation nuts), at 14s. 11d. per ton, also the tender of Messrs. Charrington, Sells, Dale & Co., for the supply of 2,000 tons of Shirebrook double screened nuts, at 13s. 5d. per ton, for the electricity supply department.

The Council has adopted, on the recommendation of the borough electrical engineer, a scheme for replacing the fittings in the above building, as follows:—Large hall, £70; corridors and cloak rooms, £67; small hall, £56; office, £20.

The Council has also accepted the tender of Messrs. Windsor and Co. for the construction of sub-stations, for the sum of £520. The Council has further accepted the tender of the Hardy Pick Co., for the supply and erection of a clinker crushing and sifting machine, for £675, subject to the work being carried out under the supervision and to the satisfaction of the borough electrical engineer.

Glasgow.—The British Westinghouse Co. has just secured an important contract for the equipment of all the Glasgow tramcars—numbering nearly seven hundred—with their magnetic brake. Experiments extending over nearly two years, on one hundred cars, have been carried out, and the present contract is the result of these trials. We are informed that no fewer than 1,300 of the Westinghouse magnetic brakes have been sold in the United Kingdom.

Hammersmith.—The Borough Council has received the following tenders for supplying motor-generators:—Messrs. Witting, Eborall & Co. (accepted at £691), £615 or £691; F. A. Glover and Co., £700; Fuller, Wenstrom & Co., £730; Geipel & Lange, £664 or £750; Lancashire Dynamo and Motor Co., £778, £832 or £971; Johnson & Phillips, £790 or £850; Electric Construction Co., £809; General Electric Co. £870; Bruce Peebles & Co., £890.

Newcastle-under-Lyme.—The T.C. has accepted the following tenders for the electricity works:—

Electric Construction Co., Ltd., two dynamos	£385 0 0
Andrews, Ltd., two gas engines	788 0 0
Crompton & Co., Ltd., switchboard	345 17 0
Electrical Power Storage, Ltd., battery	255 10 0
Cable Accessories Co., Ltd., house-service fuse boxes	—
J. S. Roberts, Ltd., socket pipes	—

Radcliffe.—The U.D.C. has accepted the tender of Callender's Cable Co. for cables, &c., for the electricity works at £5,350.

Rochdale.—The Board of Guardians has accepted the tender of Henley's Telegraph Co., Ltd., for alterations and additions to the switchboard at Dearnley Workhouse, and for the supply of cables.

War Office.—The War Office has placed an order with the Hart Accumulator Co., Ltd., for the storage battery of 54 cells required at Shoeburyness.

FORTHCOMING EVENTS.

Friday, October 23rd.—At 8 p.m. Junior Institution of Engineers. Annual general meeting at the Westminster Palace Hotel.

At 5 p.m. Physical Society. Meeting at the Royal College of Science, South Kensington. Papers on "The Bending of Magnetometer Deflection Bars," by Dr. C. Chree; "On the Magnetism of Basalt and the Magnetic Behaviour of Basaltic Bars when Heated in Air," by Dr. G. E. Allen; "Some Experiments with Electrical Oscillations," by Dr. W. Watson.

Wednesday, November 4th.—At 6.30 p.m. Institution of Electrical Engineers (Glasgow). Second Annual Dinner, at the Grand Hotel.

NOTES.

Something New in Fuels.—From an American paper we learn that a U.S. patent has been taken out covering the employment of "carbide residuum" as a fuel. This material is the by-product from an acetylene generator in which calcium carbide has been decomposed by water, and it, therefore, consists, from an unenterprising chemist's aspect, in slaked lime, which may vary in condition from an almost dry powder to a thin cream according to the proportion of water it contains. We also gather that a company has been formed to grant licences for the working of the process, which they do at the rate of $25. We are, unfortunately, unable to give our anxious readers full details, or the address of the concern; but not to deprive the patentee of all encouragement, we may mention that the patent is No. 724,214, and is dated March 31st, 1903.

The Electrical Volunteers at Work.—For several hours on Saturday night the London Volunteer companies of the Royal Army Medical Corps, assisted by a party of the Electrical Engineer Volunteers, were engaged on Wimbledon Common in very interesting work of the kind which must always follow a battle. The Medical Volunteers, who, like the Electrical Engineers, contributed largely to the Army in South Africa, were on Saturday commanded by Major Matthews: and the assumption upon which they proceeded was that a great fight had occurred on the common in the afternoon, and that many of the wounded had crawled for shelter into the wooden dell just north of the Windmill. The night was a dark and moonless one, but the seeking ambulance parties were aided in their work by the powerful searchlight brought into the field by the Engineers under Major Erskine, which made the wood as light as day. Stretchers and cycles were brought into use in picking up men presumed to be wounded in various ways, and carrying them to the several stations established by the Medical Corps, the majority of whose members are students of the Metropolitan hospital schools. A little to the rear of the searchlight the collecting station was marked by a couple of lamps shining out brightly in the surrounding darkness, and beyond these another pair of lamps indicated the dressing station, where ambulance wagons were in waiting to remove the wounded to the still more remote field hospital, pitched on the eastern side of the common. All the work, alike by ambulance men and Engineers, was well carried out on a dry and chilly night.—The *Times*.

Yorkshire College Engineering Society.—At the opening meeting of this society on Monday, October 12th, Mr. E. J. Silcock, M.Inst.C.E., delivered the presidential address, taking for his subject "The Duties of a Municipal Engineer." Mr. Silcock divided the duties of a municipal engineer into six heads:—Engineering, architecture, law, miscellaneous, surveying and admistration, and sub-divided these again into various branches. He showed the vast amount of varied knowledge which it was necessary for a municipal engineer to possess in order to deal with such important matters, as the provision of adequate water supply, sewerage and purification systems, road and bridge making, street improvements, with a view to future requirements, tramways, electric lighting and gas works, designing and supervision of buildings, heating and ventilation. He also stated that a working knowledge of all Acts of Parliament relating to municipal and sanitary laws is an essential part of the municipal engineer's training. The lecturer considered that municipal engineering offers a fair field to students, and emphasised the necessity of a sound technical training as an essential to ultimate success. A vote of thanks was accorded to Mr. Silcock.

American Municipal Failure.—An instance of municipal electricity supply system having failed in the States is quoted in a recent issue of the *Electrical World and Engineer*. The Valley City, N. D., City Council has decided to offer the electric light plant for sale. A twenty-year franchise will be given to the purchaser. There are about 3,000 commercial lights on the system, and it is said to be the largest plant, outside of Fargo and Grand Forks, in the State. It has not been a paying investment for the city, and the expenses for the past year were about $7,000 more than the receipts

Ventilation of Tube Railways.—The paper on this subject read by Mr. J. W. Thomas, at the Southport meeting of the British Association, seemed to us to call for arrangements that would not be very practicable. The use of doors for closing the tubes is, we fear, a matter of great difficulty Mr. Morrison, who discussed the paper, pointed out that it would be better to place an up-cast shaft between each two stations, and rely on the trains to force air up these. A correspondent suggests that the simplest and cheapest method will probably be found, ultimately, to comprise a two-compartment shaft midway between each station. One compartment would have light valves as of mica opening upwards; in the other there would be valves opening downwards or rather inwards. Each train, in pushing air before it, would force a considerable volume up the shaft; as soon as it had passed the shaft it would draw in a considerable volume by the down-cast compartment. Thus each train would be constantly changing the tunnel air. Moreover, the up-cast department would serve as a temperature shaft, and aid ventilation considerably. What is wanted in tube ventilation is not so much a complete change of air every night, as a constant removal of foul air the day through. As it is, the trains are exposed to considerable air resistance in the tubes. This would be diminished slightly were central shafts constructed, as these would relieve something of the difference of the pressures in front of and behind trains. As a mere matter of possibility, nothing is easier than to ventilate a tube railway by the use of doors to compel certain air movements, but, as said above, the doors are a practical difficulty with a frequent service. The intermediate shaft appears calculated to effect a very considerable improvement, though we fear it is but little better than the foregoing in point of practicability.

Oil Fuel.—Mr. Bell's paper before the British Association was merely a summary of the main points of liquid fuel burning, the latest developments of which in the direction of what he considers the best system, viz., atomising, points to the employment of oil under pressure, heated to a high temperature, sprayed with dry steam and fed with heated air for combustion. The author also pointed out that furnaces had been neglected in the attention paid to atomisers or spraying apparatus. It need scarcely be pointed out that the furnace itself is a most important part of the system. It must be lined more or less thoroughly with firebrick, as in the case of a furnace for bituminous coal. As a rule, the oil does get some such attention more or less directly, whereas coal is neglected. Another point might be made on the score of draught. Oil can be burned with a very small draught for the reason that it is or can be burned in a free unencumbered furnace, whereas coal rests on a grate which it chokes up more or less, so that most of the resistance to the draught is that of the grate and its burden. As a rule with liquid fuel the clear way through the furnace is obstructed by brick walls and additional bridges, &c., so as to check the otherwise too rapid flow of the flame and gases towards the chimney. Mr. Bell is, of course, an advocate for oil fuel, but he had nothing to say as regards the very limited production of oil as compared with coal. Liquid fuel would be perfect in a sense, if there were only more of it.

Pendulum Apparatus for Testing Steel for Brittleness.—At the Southport meeting of the B.A., Mr. Izod read a paper on the above subject. The idea of the pendulum test is that it will prove brittleness better than other tests. The tensile test, coupled with measurements of extension and reduction of area, is usually looked on as affording a fair measure of the brittleness or otherwise of a sample. It is not desirable to multiply tests. Can it be shown that pendulum tests show results inconsistent with what can be found by the usual method? Correctly to read the results of a pendulum test, the swinging weight is allowed to fall freely through a certain arc. It strikes the specimen to be broken, and its residual energy is measured in order to find that absorbed in the breaking of the test piece. As we are told the test piece must be nicked so as to locate the break, a good deal may depend upon the form and depth of the nick or notch, upon the tool with which it was made, its form and sharpness, and there appears good ground to suspect room for quite a number of errors of much more serious moment than the errors which can arise in the tenacity test. But some such test is declared to be necessary to determine the potentiality of brittleness, which the usual tests are said to be unable to show. There appears to be an unsettled feeling about steel at the present time; hence the numerous papers of late on heat treatment of steel.

Depreciation.—The annual conference of the Society of Accountants and Auditors was held at Liverpool last week. Among the papers read was one on "Depreciation and Sinking Funds in Municipal Undertakings," by Mr. Frederic Walmsley, a Fellow of the society, and chairman of the Finance Committee of the Bolton Corporation. He said that in the last 30 years, when the population had increased from 23,000,000 to 32,617,001 and rateable value from £107,398,242 to £186,563,738, loans outstanding had grown from £69,461,087 to £293,864,224, and debt per head of population from £3 0s. 4d. to £9 0s. 8d. The debt was outrunning the rateable value, and there was a fear that municipal security was to some extent being shaken. His suggestions were:—(1) Depreciation should be charged in all undertakings liable to waste, obsolescence, or supercession on terms quite sufficient to recoup or renew the assets when required without recourse at any time to re-borrowing, repairs being charged direct to revenue year by year, so as to maintain the assets in efficient condition; (2) longer periods should be allowed for the repayment of loans, especially in undertakings of a perma-

nent character, where there is no risk of obsolescence; (3) sinking fund should be charged separately without regard to depreciation; (4) all these matters should be settled by conference as previously explained, so as to establish a uniform treatment of depreciation and sinking fund in the accounts of all corporations. In the course of a discussion, the president (Mr. C. H. Wilson, Leeds), said it would be a national calamity if a body of accountants did anything to contribute to the foolish idea prevailing in the country that corporations were overspending themselves. He ridiculed the notion of the coming generation having a burden they could not bear.

Nickel Plating Efficiency.—An exhaustive series of experiments has been conducted by Mr. Oliver W. Brown, of the University of Wisconsin, to determine the exact conditions under which nickel can be most advantageously and economically deposited from a solution of its double sulphate with ammonia. The experiments have also served to explain to a large extent the extraordinary behaviour of the nickel plating bath, and the extremely unstable nature of the safe rate of deposit. It is well known that both the current efficiency and the polarisation voltage of this bath vary considerably without any apparent reason, sometimes attaining a very low value. Two nickel electrodes were electrolysed in a bath of nickel-ammonia-sulphate at current densities varying from 1·0 to 10·0 amperes per sq. ft., and the discharge potential of the cathode and anode, together with the polarisation voltage on breaking the circuit, were taken. Several different anodes were also used consisting of cast smooth, cast roughened, pure, rolled and electrolytic nickel. These anodes behaved very differently, the cast-nickel with roughened surface showing a corrosion efficiency of 91·32 per cent., while the pure rolled nickel showed only 8·47 per cent. The tendency of the cathode depositing efficiency was to attain a value of about 90 per cent., so that unless the anode corrosion efficiency approached this value the bath became impoverished and the total efficiency quickly dropped.

Whatever precautions may be taken, the anode is liable to suddenly assume a passive state, possibly due to the formation of a film of hydroxide on its surface, and this causes the depositing efficiency to suddenly drop far below its normal value on account of increased polarisation voltage and decreased corrosion efficiency. These experiments have shown, therefore, that the satisfactory operation of the nickel-plating solution depends on the character of the anode and upon its surface state. Rough-surface cast-nickel anodes, containing a small trace of copper and other electro-negative impurities, are found to be the most suitable. As regards the control of the watt efficiency by modification of the surface state, this may be obtained in the following way. The anode discharge potential should not be allowed to exceed −0·45 volt, and the most simple method of observing this rule is to have in shunt across the bath a high resistance voltmeter, upon which the polarisation voltage can be occasionally rapidly read on breaking the main circuit. If this polarisation voltage does not exceed 0·70 volt, it may be safely assumed that the corrosion efficiency is high; but if it exceeds 0·70 volt by an appreciable amount, it may be assumed that a passive state has been begun, and the anode should at once be removed, scraped, cleaned in acid, washed, and quickly replaced. If these precautions be observed, and a current density of about 5 amperes per square foot be used, the plater can rely upon having a current efficiency approaching 90 per cent. at a minimum potential difference.

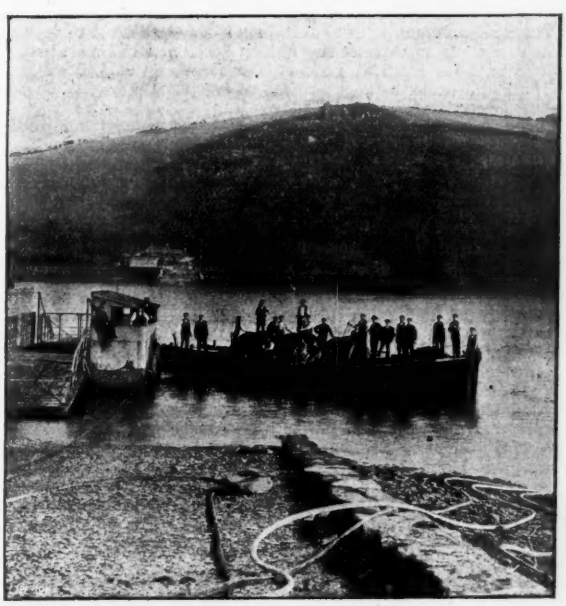
Dundee Engineers.—A number of the members of Dundee Institute of Engineers and Society of Experimental Engineers have visited the electrical works of Messrs. Mavor & Coulson, Ltd., the works of Messrs. Duncan, Stewart & Co., and the electric power station at Pinkston.

Water-Power Plants in America.—The New York *Electrical World and Engineer* gives an abstract of a paper read before the September meeting of the American Institute of Electrical Engineers by Mr. George A. Henry, Jun., and Joseph Le Conte on "An Efficient High-Pressure Water Power Transmission Plant." The paper was devoted to a description of the Pelton water wheels used in the new plant of the Edison Electric Co., of Los Angeles, California, and records of tests made on the wheels. The head utilised is equal to 1,960 ft. vertical fall, corresponding to an effective pressure at the wheels, allowing for friction loss, of 825 lbs. per sq. in. The power of the wheels is controlled by means of a combined throat needle and deflecting nozzle. The nozzle is operated automatically by a governor, and the needle is controlled by hand. Each generating unit is of 750-KW. normal capacity at 430 r.p.m., with a margin for 50 per cent. of overload; the number of units and the voltage were not given in the paper. The authors described the pipe line, water wheels and governing arrangement in detail, and gave the results of tests to determine the efficiency of the wheels for different loads and styles of nozzle tips. The experiments showed the necessity for very careful calculation to establish the more efficient shapes of needle and tip. The tests gave wheel efficiencies varying from 76·5 per cent. at 482 KW. to 86·8 per cent. at 826 KW.

In the discussion of the paper Mr. F. O. Blackwell gave further details of the Los Angeles transmission, formerly known as the Redlands plant, and the first three-phase transmission plant in the country. The line voltage is 35,000, and there are seven power stations located up to 100 miles apart, all feeding the same transmission line. The Edison Co. is now developing on Kern River a new station which will have a capacity of 20,000 H.P., and will generate at 60,000 volts and transmit to Los Angeles, 150 miles distant. The diameter of the wheel referred to in the paper is 7 ft., and that of the nozzle 2 in., giving a ratio of 40 to 1, the usual ratios being from 5 to 10, to 1. The needle nozzle not only increases the efficiency at partial load by cutting down the water used, but increases the efficiency at the bucket, since the stream is directed at the centre of the same. The original Redlands plant had an efficiency of 70 per cent. at full load, which has been increased to 85 per cent. at full load, and 75 per cent. at half load, while the regulation is within 2 per cent. The high-head part of the pipe line has forged flanges. Mr. H. A. Lardner said that the Santa Ana pipe line is of steel pipe with flanged joints bolted together, with no provision for expansion, the head being 900 ft. Since the water in the case of the California plants has about the same temperature throughout the year, it is probably not necessary to provide for expansion; moreover, nearly all lines have a considerable curvature, horizontally or vertically. The Standard Co. has a cast-iron section for the upper third of its pipe line, each length of pipe being firmly grouted into the rock on the side of a mountain. A riveted pipe line in Colorado has given some trouble. Some of the wheels of California plants have two sets of runners and two nozzles, the latter being both full on, or one partially on or entirely off, depending on the load. President Arnold said that in the majority of cases it is found desirable to put in a steam plant rather than rely on water power, except where the price of coal is very high.

A Newport Claim.—At Newport Board of Guardians last Saturday, a letter was read from Messrs. Davis, Lloyds and Wilson, solicitors, with reference to a claim by the Walsall Electrical Co. for damages, owing to the delay of the contractor for the building of the new workhouse now being erected for the Board. A sub-committee having considered the matter, had recommended, and the Guardians now confirmed this: "That the clerk be instructed to inform the Walsall Co. that the Guardians were not liable for the delay, and declined to entertain the claim." The Newport borough electrical engineer had stated that the contractors had provided an excellent installation.

Laying a Subaqueous Electric Light Cable.—The local authority of Kingswear recently made arrangements with the Urban Electric Supply Co., Ltd., of Dartmouth, for the supply of electricity in the district for lighting purposes; to carry out the scheme it was necessary to lay cables across the River Dart. This was successfully accomplished by the company's staff, on the



Laying Cables Across the River Dart.

3rd inst., when three cables were lowered to the bed of the river near the crossing of the "floating bridge." The total distance is about 550 yards. The cables were specially made by Messrs. Callender's Cable and Construction Co., Ltd., and are of the single-core type, insulated with bitumen and armoured. The accompanying illustration shows the operation of laying in progress.

Electric Motors for Centrifugal Pumps and Fans.—At last month's meeting of the American Institute of Electrical Engineers, Mr. Augustus J. Bowie contributed a paper on the above subject. According to the *Electrical World*, the subject was treated under the following heads:—Constant speed and varying load: changing speed with head varying directly as square of speed; constant head and varying speed. Mr. Bowie points out that a centrifugal pump, when operated at too low a head, shows a very low efficiency. In general, however, with a well-designed pump, the range of efficient operation for a constant speed is fairly broad. He emphasised the danger of overloading a motor through too low a head. A manufacturer will usually guarantee a certain efficiency and input for a pump at its rated load, but will say nothing concerning the power required to drive it at heads lower than that called for. The question may arise—Why not give a pump the proper speed for a given head? This is frequently impracticable,

since pumps must often be installed to work under widely varying heads, where it is not an easy matter to change the speeds. Oftentimes the heads to which the water must be elevated will vary practically from zero to the maximum head against which the pump will deliver. In some cases these overloads may be of long duration, and a sufficiently large motor should be installed. On the other hand, the maximum load will often be only of short duration, as, for example, in the case of pumping from a well, particularly where there is a pit in connection with it, which is partially filled up with water. Generally it will not take the pump long to lower the water considerably, and the duration of overload will be brief. Increasing the speed of the rotor, where the effective head varies as the square of the speed, will result in increasing the capacity of the pump directly as the speed, and increasing the power input and output directly as the cube of the speed. The condition presupposed in this case, namely, that the head varies as the square of the speed, is the condition which exists in the case of ventilating fans.

The condition of constant head exists when pumping against a fixed lift, when the velocity heads lost at entrance and discharge, and the frictional losses in the pipe, may be disregarded in comparison with the lift.

In this case the input increases faster than the cube, and not as fast as the fourth power of the speed. Ten per cent. increase in speed represents 40 per cent. increase in power and 96 per cent. increase in the c^2R loss in the armature. From this it may be seen what an extremely large effect speed variation has on motors driving centrifugal apparatus. There is, perhaps, no other form of apparatus so sensitive to change of speed in its power consumption. The effect which a steady pump load has in holding the voltage constant by preventing the racing of generators is thus explained.

Mr. Bowie considers that speed control of direct-current motors by variation of field resistance has a limited range in practice and has many points which tend to make it objectionable for the best conditions of commutation. Even at best there will be considerable field distortion at the high speeds. The effect of a load which would increase as the cube of the speed, and even faster, would seem to limit still further the allowable speed variation to be obtained in this manner. While the output of a centrifugal pump varies directly as the speed of revolution, many manufacturers rate their pumps at a fixed volumetric output, and publish a list of suitable speeds for different heads under which it may be desired to operate the pump. In some cases the highest speed given in these lists is three or more times as great as the lowest speed. Such misinformation leads to a great deal of trouble and cannot be too strongly condemned.

The paper includes curves from tests of centrifugal fans, giving the relation between pressure, input, output and efficiency.

In introducing the discussion, President Arnold said that anyone who has attempted to vary the speed of a motor working on a pump and got the former working at a speed too high for the pump ought to be able to appreciate the considerations laid down in Mr. Bowie's paper. Mr. Stott said that the variation of power taken by centrifugal pumps under different heads is so complex that it seems impossible to make any equitable flat-rate for electric power for that service, and wattmeters should be installed. His experience with shunt-wound motors applied to centrifugal motors working on barometric condensers has been unfortunate; a variable speed motor is indicated for this use, since in starting, a speed at least 15 per cent. above normal is required. Mr. J. J. Brown disagreed as to this point, saying that recent developments have shown that within reasonable variations of head, such as 10 to 20 per cent., constant-speed motors can be used on barometric condensers without serious overload. Mr. F. O. Blackwell said that the very-high-head centrifugal pumps with several sets of rotors, each one feeding into the next one, form a development extremely promising, and in time he believes it will replace the reciprocating pump altogether for all heads. These pumps are being made with each rotor up to 100 ft. head, and there have been as many as seven or eight sets of rotors connected together, which would give 700 or 800 ft. total lift in the pump; the efficiencies have been very high, too. Eighty per cent. efficiency has been obtained with these high head plants with the centrifugal pump, which is practically as good as that of any reciprocating pump.

A Warning.—Some time ago a firm in Cardiff, styled the British American Electrical Maintenance Co., advertised for premium apprentices, holding forth the inducement that good positions would be secured for those who deposited their money with the firm. We were at the time somewhat dubious as to the *bona-fides* of the concern, and our suspicions have recently been justified, for we learn from a correspondent that the manager (who was also the proprietor) has absconded, leaving at least one apprentice in the lurch, but without refunding the premium of £30. While it is too late to warn our readers against this particular concern, we wish to put them on their guard against similar undertakings; full inquiries should be made into the true standing and prospects of any small firm professing to train apprentices in engineering "for a consideration," and as to the number of apprentices employed in the business. If the proportion of apprentices to workmen be unduly large, it is safe to say that the training will be of a worthless description, and the premiums worse than wasted.

The pity of it is that it is generally impossible to convey this oft-repeated warning to the parents of the would-be apprentices, as they naturally are not habitual readers of the technical Press; frequently, too, the victims of this cruel imposition are precisely those members of the public who are least able to bear the loss of the premiums, to pay which they have been obliged to practice self-denial.

Personal.—Mr. C. H. Wordingham having taken up his position with the Admiralty as electrical engineer-in-chief to the Navy, he has disposed of his consulting practice formerly carried on at Manchester, to Mr. Thos. L. Miller, who has practised as a consulting engineer in Liverpool and London for some years past. Mr. Miller has taken over Mr. Wordingham's offices at 19, Brazennose Street, Manchester, and will continue to practice from that address as well as from his own office at 7, Tower Buildings, North Water Street, Liverpool, and at 61, Old Broad Street, London, E.C., under the style of Miller & Collins. Mr. Miller has also taken into partnership Mr. H. W. Wilson, who has been for some time engineer to the Lancashire branch of the British Thomson-Houston Co., Ltd. The Manchester and Liverpool businesses will in future be carried on in the name of Messrs. T. L. Miller & Wilson.

Mr. L. H. Enler, A.M.I.E.E., has been appointed teacher of electric lighting and power at the Walthamstow Technical Institute.

The staff of the new electric tramways at Glossop have presented Mr. C. E. Knowles, J.P., the general manager, and Mr. H. Emmett, the superintendent, with their photographs framed, as a memento of the opening of the system. The Hon. Mrs. S. Hill-Wood, who drove the first car, presented Mr. Emmett with a diamond and turquoise pin.

Mr. O. Hughes, on resigning the post of tramways inspector at Sunderland to take up a similar position under the Ipswich Corporation, has been presented by the staff with a travelling bag, combination set, gold mounted cigar holder, silver match box and sovereign purse.

Mr. J. E. Lickfold, the well-known solicitor, who successfully conducted for us all the law cases in which the Electrical Review was involved in connection with the Electropathic Belt actions, has removed to 57, Moorgate Street, E.C.

Mr. Hooghwinkel, M.I.E.E., has resigned his position as chief assistant engineer to the Brush Electrical Engineering Co., and has established himself as consulting electrical engineer at Dacre House, 20—22, Victoria Street, S.W. Mr. Hooghwinkel, who formerly acted as chief assistant engineer to Messrs. Siemens and Halske and the Electrical Power Distribution Co., is especially devoting himself to advising on electrical mining and traction plant.

Three candidates for the position of manager of the L.C.C. tramways, rendered vacant by the resignation of Mr. Baker, attended a meeting of the General Purposes Committee of the Council on 19th inst. They are Mr. Hamilton, of Leeds, Mr. Fell, of Sheffield, and Mr. Nicholson, who is connected with the management of a Lancashire railway.

Mr. Frederick S. Grogan, A.M.I.E.E., who has been with the British Thomson-Houston Co. for the past three years, has been appointed chief assistant engineer to the British Electric Equipment Co. in London. Mr. Grogan, during his association with the B.T.H. Co., has been chiefly engaged in tramway construction work, among other places at Huddersfield and Croydon, but latterly has been attached to the company's construction department at their Rugby Works. Previously he was for five years an assistant engineer in the Corporation electric supply station at Belfast.

Non-Inflammable Wood.—Since the recent terrible accident on the Paris underground electric railway, considerable attention has naturally been drawn to the possibility of similar occurrences on the lines in this country, and numerous announcements have been made by those interested to show that every possible precaution has been taken to secure the safety of passengers from fire by means of isolating the motor equipment in fireproof compartments, and constructing the rolling stock of non-inflammable wood. A good story in this connection comes from one of the large works where railway and tramway cars are built, and where some little time ago a considerable amount of timber treated specially for this purpose was obtained and put into use. Most of the scrap from the car-shops at these works goes, as is very usual, into a wood-burning boiler furnace, used to give steam for one purpose or another; and without saying anything to the unfortunate stoker as to the character of the stuff, a lot of the non-inflammable shavings and pieces were given him for starting his fire. The report says that his language was enough to light the fire, though the shavings wouldn't do it!

Pretty Capacious!—A Glasgow evening paper is responsible for the following paragraph, which, on the face of it, seems an excellent instance of mistaking conduits for cables. Three feet square of copper at present prices would come to quite an appreciable amount per mile run, and if we mistake not, the Clyde Valley Co. serves an extended area. However, let the paragraph speak for itself:—"Good progress, I learn, is being made at Motherwell with the construction of the power station for the Clyde Valley Electrical Power Co., Lanarkshire's newest and largest electricity concern. As giving an idea of the immensity of the business this firm propose to accomplish, I am told that their main cables will be 3 ft. square! As may be easily imagined, the worthy Councillors of Steelopolis have had not a little anxiety as to how these mains should be stowed away in their streets."

London County Council.—The Council at the meeting on Tuesday resolved to advance £23,960 to the St. Pancras Borough Council for electric lighting purposes.

The Highways Committee reported that certain short lengths of tramways exist in the county, forming part of the North Metropolitan Tramway Co.'s system, which was not included in the lease granted to the company. Steps had recently been taken by the company to reconstruct those particular lines for electric traction,

and the Board of Trade had approved the system proposed to be used. The work, which was being carried out under powers conferred upon the company in 1897, had to be completed within two years from the date of the Act becoming law, and the Committee were advised that the company was acting illegally in proceeding with the work. As the tramways affected were purchasable by the Council, and would probably be worked in conjunction with the lines leased to the company, it was most important that the Council should have a voice in the system of traction to be adopted. The Committee had therefore given instructions for an action to be instituted to prevent the company from proceeding with the works. As the action would have to be entered in the name of the Attorney-General, the County Council being relators, it was necessary for the seal of the Council to be affixed to a formal authority to the solicitor to act on its behalf in the proceedings to be taken.

It was announced by the Improvements Committee that accounts had been submitted by the expert witnesses engaged by the Council in connection with the claim of the Metropolitan Electric Supply Co. in regard to the reinstatement of the Sardinia Street station. The accounts as certified by the Council's officers were as follows:—Kincaid, Waller & Co., £1,462 3s. 5d.; J. Swinburne, £185 6s. 6d.; C. H. Gadsby, £1,116 4s. 11d.; Gordon & Gunton, £638 15s. 3d.; C. Hugman, £488 8s. 3d.; J. H. Andrews, £157 18s. 6d.; S. B. Cottrell, £111 5s.; J. Statter, £163 16s.; Holloway Bros., £157 10s. The company's claim originally amounted to £400,000, but this was subsequently reduced by the company to £320,931, and the arbitrator awarded £183,150. In view of this very favourable award, which was largely attributable to the evidence given by the Council's witnesses, and having regard to the fact that the witnesses had to work under great pressure in preparing their evidence, the committee thought the sums charged were reasonable, and they had therefore given instructions for the payment of the accounts.

Motor-Wagons, Tramways and Other Topics.—Sir Oliver Lodge, Principal of Birmingham University, dealt with several everyday topics from the scientific standpoint at Wolverhampton on Monday in this week. He evidently looks to motor-wagons and automatic cars as the vehicles which will enable us to solve the difficult problem of convenient transit of various commodities without re-handling and re-shipment. He hopes motor-wagons will open up the country to a remarkable extent. Railways, he observed, would continue to have their use on the main traffic lines laid with metal track for high speeds, but he should like to see a system of motor-wagon carriage direct to the nearest railway line, where the vehicles could be placed on the metals and sent to the destination. Speed was not of moment. What was wanted was direct communication. Talking of locomotion reminded him that trams were a burning question at Wolverhampton. They in Birmingham managed to keep a certain company out, and keep this important source of employment and benefit for citizens in their own hands. The country looked to Wolverhampton for the result of a most interesting experiment. He hoped it would be successful. He had been hoping the surface-contact system would be found to be feasible and prove worthy in all ways, because it was the best if only it was not too expensive and ornamental. Birmingham might be able to take advantage of experiments at Wolverhampton. Sometimes he thought motor-cars more suitable for main streets, and that rails should be kept for side streets; but time would show. The thing to aim at was differentiation of traffic.

Obituary.—We learn with regret of the death of Mr. William Lund, of the firm of Lund Bros., electrical engineers, of London, which occurred on October 13th, at Southport. Mr. Lund was only 33 years of age, and death was the result of ptomaine poisoning.

Appointments Vacant.—King's Norton and Northfield U.D.C. wants a clerk of works for the electrical equipment of tramways; correspondence clerk for Woolwich electricity works (£90). See our advertisements to-day.

THE CENTRAL STATION ENGINEER.

Three candidates for the position of electrical engineer for Burslem were interviewed by the Electric Lighting Committee, and Mr. Ashton Bremner was appointed at £200 per annum.

Mr. D. C. Redfern has been appointed to succeed Mr. W. Whitney as assistant mains superintendent at the Southport Corporation Electricity Works.

On Thursday, 15th inst., an enjoyable evening was spent in the City Hotel, Dartford, by the engineering department in connection with the City of London Asylum. Mr. D. A. Beveridge, assistant engineer, occupied the chair. The event of the evening was the presentation to Mr. C. E. Clayton, resident electrical engineer, of a handsome bronze statue timepiece. Votes of thanks to singers and to the orchestra brought a happy evening to a finish.

At the meeting of the Morecambe Town Council on Monday, the appointment of Mr. W. H. Hall, of Bootle, as electrical engineer in succession to Mr. Pape (who has gone to South Africa) was confirmed. There were a large number of applications, the final six being:—Mr. W. H. Hall, Bootle; Mr. C. H. Yeaman, Islington; Mr. J. J. Hargreaves, Morecambe; Mr. B. S. H. Hornby, of Bolton; Mr. J. B. Bingham, Kirkcaldy; Mr. R. A. D. MacAlister, Greenock. The first three appeared before the Committee, and Mr. Yeaman got the appointment, but after accepting it he sent a letter declining the post, and Mr. Hall was offered it and agreed to take the position.—Mr. A. W. Annetts has been appointed chief assistant engineer.

Mr. F. Broomfield, inspector of electrical fitters in H.M. Dockyard at Chatham, has just been presented by the officers and men in the electrical department of the yard with a gold ring and gold Albert chain on his being promoted to the post of assistant electrical overseer in the Thames district. The electrical engineer (Mr. Leonard Newitt) also presented Mr. Broomfield with a fountain pen. The electrical department in Chatham Dockyard is developing to a very considerable extent, and there are now large workshops and offices fully at work in connection with the fitting out of H.M. ships of war, and other works in the Dockyard.

At the Salford Corporation Electricity Works on Friday last, Mr. W. H. Alabaster was presented with a handsome dressing case on the occasion of his leaving Salford for Melbourne. Mr. C. D. Taite (borough electrical engineer), with an appropriate speech, made the presentation on behalf of the staff and men, of whom a large number were present.

ELECTRICITY SUPPLY ACCOUNTS.

Salford Municipal Electricity Supply.

If the year's working of the Salford undertaking has not resulted in a net profit, at least the indications are that another year will see the turn of the tide of adversity. The improvements are all round, the output having increased nearly fourfold, and the load factor having grown to very creditable proportions. Much of the improvement is due to the development of the tramways, the whole of the routes being now worked electrically.

Power consumers have rapidly increased, and at the present time are being supplied at a rate equivalent to 700,000 units per annum. Some 336 H.P. of motors are on hire from the Department.

Turning to the works costs, a great improvement has taken place, which has been largely contributed to by the satisfactory running of the new works. As the department was working two stations during five months of the year, it is probable that the figures will be still further improved during the ensuing year.

The prices charged are:—For lighting, 4d. per B.T.U.; for power, 2d. to 1½d. flat rates. Mr. C. D. Taite is the borough electrical engineer.

General Statement.

For year ending March 31st—	1903.	1902.	Inc.
Total capital expended	£487,708	£385,461	£102,247
Number of units sold—			
Lighting	908,354	795,107	—
Power	334,507	—	—
Public lighting	150,328	19,271	—
Traction	3,370,434	458,380	—
Total	4,763,623	1,272,758	3,490,865
Equivalent No. of 8-c.p. lamps ...	90,573	73,743	16,830
H.P. of motors connected	1,005	488	517
Public arc lamps	108	108	—
Maximum load in kw.	2,490	1,200	1,290
Load factor	21·9	12·1	9·8
Revenue Account—			
Gross revenue	£45,921	£17,728	£28,193
„ expenditure	£21,877	£16,472	£5,405
„ profit	£24,044	£1,256	£22,788
Average price per unit obtained—			
Private supply	3·09d.	4·08d.	—·09d.
Public lighting	1·29d.	2·11d.	—·82d.
Traction	1·95d.	1·95d.	·00d

Revenue Statement.

	1903. Gross.	Per uni
By sale of energy	£43,833	2·21d.
Rentals of motors, meters, &c., and lamp charges	1,530	·07d.
Property rents, sales and premiums	558	·03d.
Gross revenue	£45,921	2·31d.

Cost of Production.

For year ending March 31st—	1903. Gross.	Per unit.	1902. Per unit.	Inc.
Coal, &c.	£5,906	·29d.	·84d.	—·55d.
Oil, waste, water and engine-room stores	1,058	·06d.	·14d.	—·08d.
Wages and salaries incurred in generation and distribution	3,119	·15d.	·56d.	—·41d.
Repairs and maintenance of buildings, machinery, plant, &c. ..	6,887	·35d.	·97d.	—·62d.
Works and distribution costs	£16,970	·85d.	2·51d.	—1·66d.
Public lamps, attendance and maintenance	697	·04d.	·01d.	+·03d.
Rent, rates and taxes	1,606	·08d.	·12d.	—·04d.
Management and general expenses, including salaries of engineer and clerical staff, general establishment charges, printing, stationery, insurance, &c.	2,603	·13d.	·46d.	—·33d.
Total works cost	£21,876	1·10d.	3·10d.	—2·00d.

PROFIT STATEMENT.

	1903.
To interest on loans	£13,923
„ sinking fund	12,031
Sundry	484
Deficit on year's working	—2,394
Gross profit	£24,044

On the year's working the department made a gross profit of £24,044, as compared with £1,256 last year. Financial charges absorb £26,348, as compared with £14,470 last year, and a deficit of £2,394 remains, as compared with a similar deficit of £13,214 last year.

York Municipal Electricity Accounts.

THE returns of the York undertaking for the past year are, at first sight, disappointing after the first two years' excellent results. During the year the Department has gone in for large extensions, to cope with the phenomenally increasing demand, and especially to provide for the coming traction load; it has also taken over the management of the destructor. These rapid developments have resulted in abnormal expenditure, which will, however, place the Department in an excellent earning position in the near future.

Power consumers have connected and applied for some 350 H.P. of motors, and this desirable class of consumer should increase at the present scale of charges. The fact that the Department has ended the present year with a deficit must be ascribed to the inadequate proportions of the original scheme. The city electrical engineer is MR. C. A. Midgley.

GENERAL STATEMENT.

Year ending March 31st—	1902.	1903.	Inc.
Total capital expended	£55,832	£69,428	£13,596
Number of units sold	423,000	652,000	229,000
Equivalent number of 8-C.P. lamps connected...	32,766	43,167	10,401
Number of public lamps	66	66	—
Maximum load in KW.	410	550	40
Load factor	11·88%	14·15%	2·27%
Revenue account—			
Gross revenue...	£6,110	£7,373	£1,263
„ expenditure	£3,518	£5,152	£1,634
„ profit	£2,592	£2,221	— £371
Average price obtained—			
Private lighting	3·62d.	2 69d.	— ·93d.
Public „	2·70d.	2·61d.	— 0 9d.

The increase in output during the past year amounted to 229,000 units, compared with a similar increase of 200,631 in the previous year. Reductions in charges and the increase of power consumers account for the decreased average prices.

The charges are:—For private supply, 7d. and 1½d. per B.T.U. on the maximum demand system, or an alternative flat rate of 4½d. to 3d.; for power, 1½d. to 1d. per unit.

REVENUE STATEMENT.

	1901-2.		1902-3.		
	Gross.	Per unit.	Gross.	Per unit.	Inc.
Sale of energy ...	£6,034	3·42d.	£7,261	2·68d.	—·74d.
Motor and meter rents	12	·00d.	110	·04d.	+·04d.
Sundry fees, &c. ...	64	·04d.	1	·00d.	—·04d.
Gross revenue ...	£6,110	3·46d.	£7,372	2 72d.	—·74d.

COST OF PRODUCTION.

For year ending March 31st—	1903. Gross.	1903. Per unit.	1902. Per unit.	Inc.
Coal	£1,433	·62d.	·71d.	—·19d.
Oil waste, water and engine room stores ..	212	·08d.	·16d.	—·08d.
Wages incurred in generation and distribution and attending public lamps	697	·33d.	·28d.	·05d.
Repairs and maintenance of buildings, machinery, plant and public lamp renewals	1,012	·37d.	·26d.	·11d.
Works and distribution costs	—	1·30d.	1·41d.	—·11d.
Rents, rates and taxes	426	·16d.	·13d.	·03d.
Management expenses, including salaries of engineer and clerical staff	794	·29d.	·35d.	—·06d.
General establishment charges, printing, stationery and insurance	378	·14d.	·09d.	·05d.
Total works cost	£5,152	1·89d.	1·98d.	—·09d.

PROFIT STATEMENT.

	1901-2.	1902-3.
Interest and sinking fund ... ...|	£2,243	£3,469
Balance (profit of loss)	349	—1,248
	£2,592	£2,221

As a result of the heavy capital expenditure, financial charges are largely increased, and as the gross profit is less than last year, a considerable deficit, amounting to £1,248, arises; previous balances carried forward, however, effect a reduction of £449—leaving some £800 debit balance.

CITY NOTES.

Cuba Submarine Telegraph Co.

AT Wednesday's meeting MR. PARRISH, in moving the adoption of the report (which we printed last week), spoke very hopefully of the work of development which is proceeding in Cuba, and has already resulted in an increased revenue for the company. The company had also benefited this half-year by interruptions which had occurred to the French Company's cables. The total income was £19,325, and the working expenses £6,066. He expressed disappointment at the delayed settlement of the Cuban Government subsidy owing (£9,000), and the war claim against the United States Government. The result for the half-year, however, was better than the company had been accustomed to for some time.

The report was adopted.

Kalgoorlie Electric Power and Lighting Corporation, Ltd.

THE report for the year ended December 31st last, states that although power was supplied to the Kalgoorlie Electric Tramways, Ltd., at an earlier date, the transmission lines to the mines were not in use until November, 1902. It should, therefore, be satisfactory to the shareholders to learn from the accounts that, despite the fact that only a few consumers were connected prior to December 31st, the difference between receipts and expenditure in Western Australia for the whole year is a debit of only £681. From the many applications and inquiries received from probable consumers, the directors had hoped to be in a position to state that all the power available had been contracted for, but regret that owing to the depression in the West Australian market for the past two or three years having caused many of the smaller mines, which were working at the time of the inauguration of the plant, to cease or curtail operations, and that the larger companies contend the price for power is somewhat high, less than one-half of the power available, has so far been definitely sold. Negotiations are going on, and, as new contracts are constantly being made, it is expected the plant will be fully loaded within a few months. The next accounts to be submitted to the shareholders will show a revenue account, and, that the profit earned may be available for dividend on the preferred shares, the directors recommend that the items charged to general expenditure during construction to December 31st, 1902, be carried to capital account. It will probably be more in accordance with the wishes of the shareholders to write off a percentage year by year as the profits permit, than to devote the whole of the first profits to wiping it off promptly.

The fourth ordinary general meeting of the shareholders of this corporation was held on Tuesday at Winchester House, Old Broad Street, Mr. Roger Wallace, K.C., presiding.

The CHAIRMAN, in proposing the adoption of the report, said he must first explain why the meeting had been held at a later date this year. When they were dealing with a business which was such a long way away, they could not get their accounts at a very early period in any case, and for some months now there had been some very important negotiations going on in reference to the business, which he had hoped they would have been able to have talked about that day. However, it would not be advisable to say more about the matter now, and the board felt that it would not be advisable to postpone the meeting any longer. He hoped within a short time to be in a position to tell the shareholders something about those negotiations. With regard to the accounts, when they last met there were calls unpaid to the extent of £36,000 odd, and during the year they had collected some £27,427, and since the close of the financial year, a further £4,000, which only left a very small residue of calls unpaid. That had not been a very easy position for the directors, but they decided upon a very lenient policy in collecting the calls, and the result showed that they had acted very wisely in not dealing too hardly with those who were defaulters in respect of their calls. The only people they were hard upon were those who said that there had been misrepresentations in the prospectus, who had been compelled to pay in full. Regarding the issue of debentures, of course, while they had been collecting the calls, their treasury had not been so full as they would have liked, and it had not been easy to issue debentures. The directors had, therefore, instead of issuing debentures, borrowed money from the bankers at a cheaper rate, only issuing debentures as they were actually required. Up to the present time they had issued about £24,000 of debentures, leaving £26,000 more to issue. They were 6 per cent. debentures, and were a very good property, because the company's plant was in a very excellent condition, and the only other question for a debenture holder to consider was as to whether the interest was likely to be paid for a long time, and that the place in which the company was situated was likely to demand the commodity which they supplied. The board thought they had satisfied themselves on those points at the time the company was floated, and later investigations confirmed them in their belief as to the per-

manence of Kalgoorlie as a large gold-producing centre, and capable engineers had no hesitation in predicting a long life for the mines already opened. They did not intend to offer these debentures to the public, but to reserve them solely for the shareholders. The position of Mr. Crocker, as manager, was very satisfactory. In the first instance, they had very great difficulty with their managing board in Australia, and they had to get rid of their first manager. The work that Mr. Crocker was doing was pre-eminently satisfactory to the whole of the board, and it was quite a pleasure to have his detailed statements before them. The plant was one of the best mining plants to be found anywhere, and, perhaps, the only thing they had been disagreeably disappointed in had been the supply of water in Kalgoorlie. The water supply now was much better than anybody anticipated, and they had very excellent condensing plant, which, in the end, would put them in a position of being able to sell electricity at a cheaper rate. As to their contracts, they could have sold the whole of their supply, but not at a price which would be remunerative to the company. Their object was to get contracts which would run as far as possible for the whole 24 hours in the day, and so they would go on picking out their load until they got the whole of their supply taken up on a remunerative basis. Since the present accounts had been issued, they had obtained a large number of new customers, and were getting fresh contracts every day. He had no doubt that next year they would be in a position to pay the shareholders a dividend, as the remittances from Kalgoorlie were increasing every month. This was really the first year they had been able to get to work, and next year certainly there would be money available for dividends. Before, however, they paid any dividends, it would be necessary that they should put to capital account the sums which had been expended in preliminary work, and, knowing all the circumstances of the case, he thought the board would be quite justified in adopting that course. In conclusion, the chairman remarked that two of the directors had retired, and those remaining had agreed that from this date they would only take £1,000 a year to be divided among them, instead of the full amount they were entitled to under the articles of association.

Mr. E. Pope seconded the motion.

Considerable discussion ensued, in the course of which several shareholders expressed their dissatisfaction that the report did not contain later information regarding the condition and prospects of the company.

The Chairman, in reply, said he could assure the shareholders that the business was increasing, and the units sold in August and September exceeded those sold in July. He felt confident that if only the shareholders would exercise patience and hold to their shares, they would be thoroughly satisfied when he came to speak to them at the next meeting.

The report was then adopted.

Underground Electric Railways Co. of London.

Mr. C. T. Yerkes presided at a general meeting of this company, held at Hamilton House, Victoria Embankment, on 15th inst. From an account of the proceedings officially provided for the Press, we learn that the chairman, in moving the adoption of the first annual report, said that it showed that the company had, up to June 30th last, received out of its resources a total amount of cash of £6,519,672, and had spent of that sum £5,600,222, leaving a balance of £919,450, which was at the London and Westminster Bank, Ltd., and also on hand and at short call. An amount of £6,999,931 of profit-sharing notes had been negotiated, and it was from these notes and also from the sale of securities which they received from the different companies with whom they had contracts that the directors were realising the funds to carry on the work of construction. After these notes were negotiated, the total amount of capital required was then assured, and he had to congratulate the shareholders on the fact that even in these hard times the company would certainly not want for funds to finish its work. These notes were payable at the end of five years at interest at the rate of 5 per cent. Since the company was formed its business had been carried on continuously and with vigour, as the results of the construction showed. The power house would be the largest of its kind in existence, and, with the exception that more time had been used in its construction than they had anticipated, the whole work was most satisfactory. It had been the desire of the management to purchase in this country everything pertaining to the construction, and while they had accomplished that to a great extent, still there had been some material which had come from Germany owing to the fact that it could be produced there much cheaper than in England. In this manner they had kept most of their expenditures in Great Britain. This was a very propitious time for building, and they had been enabled to reap the advantage of the low prices which now prevail; consequently their expenditures had been considerably within their estimates made at the time the company was organised. The Metropolitan District Railway would be the first plant to operate with electricity, and the construction going on there was progressing rapidly. The line which they had put down and were working to South Harrow had been of great service to them, for the reason that it discovered to them some defects in mechanism, and also showed what it would be to their advantage to adopt. The experiments they had tried in regard to safety devices had been very exhaustive. Owing to certain circumstances which had developed recently, the importance of non-flammable material in the tunnels had been much more intensely demonstrated, and consequently they had decided that nothing inflammable in the way of construction must go into the tunnels. A fire could easily be prevented if proper care were taken, and intelligence and experience used. A fire on the surface was fraught with very little danger, but one underground was an entirely different matter. The platforms in the tube stations would be made entirely of cement, while those of the District road which are now wood would be taken out and cement substituted. The wooden stairways would also be removed, and iron ones put in their places. The rolling stock would be of a pattern of their own. The underground work on the Baker Street and Waterloo road was practically finished, and attention was now being turned to the completion of this line, as it was desirable that it should be ready simultaneously with the Metropolitan District road, and they expected to make a connection between these two lines at the Charing Cross station of the District Railway. The Baker Street and Waterloo Co. had also decided to extend its lines from Waterloo Station to the Elephant and Castle, and the work there was now being pushed forward rapidly, while the extension from Baker Street to Edgware Road was about to be commenced. When this latter was finished, the line would be still further carried on to Paddington. The other lines—the Great Northern, Piccadilly and Brompton, and the Charing Cross, Euston and Hampstead—were making good progress. The acquiring of the London United Tramways had been a great advantage to the system, and they intended to connect directly both the Great Northern, Piccadilly and Brompton and the District Railways with that line, so that passengers would have an almost uninterrupted passage from Bow, and also from Finsbury Park to Hampton Court.

The report was adopted.

Monte Video Telephone Co.

The directors' report, to be presented to the meeting to be held at Winchester House on Thursday, October 29th, reads:—

The accounts for the year ending July 31st last show a net profit for that period of £12,224 8s. 1d., after providing for all working expenses in Monte Video and London. To this amount should be added the sum of £1,064 3s. 10d. brought forward from last year, leaving an available balance of £13,288 11s. 11d. From this sum the directors propose to transfer £5,000 to reserve fund, and they recommend that, after payment of the full dividend at the rate of 5 per cent. per annum upon the preference share capital, a dividend at the rate of 3 per cent. per annum be paid upon the ordinary share capital, and that the balance of £1,788 11s. 11d. be carried forward. The company has acquired, as from June 12th, 1903, the rights, privileges and properties of the undertaking known as La Hispano Uruguaya, comprising a system of telephone lines and exchanges outside the city and province of Monte Video, which materially enlarges the territory occupied by the company.

Drake & Gorham, Ltd.

The second annual meeting was held at the offices, 66, Victoria Street, S.W., on Tuesday, October 20th, Mr. B. M. Drake presiding. He moved the adoption of the report for the 12 months ended June 30th, 1903, which showed that the result of the year's trading had been eminently satisfactory in spite of the somewhat depressed condition of trade.

After payment of all charges, including bonuses due to staff, there remains a net profit of £16,327 6s. 3d., which with the sum of £3,245 18s. 4d. brought forward from the previous year, makes a total of £19,573 4s. 7d., which it is proposed to appropriate as follows:—

By payment of a dividend at the rate of 3 per cent. per annum	£10,000	0	0
By carrying forward	9,573	4	7
	£19,573	4	7

As the clause in the company's articles relating to the special reserve was held in counsel's opinion to preclude the formation of an ordinary reserve fund, the directors, acting under legal advice, recommend the substitution of the more usual clause to which reference is made in the enclosed notice. Subsequent to the extraordinary meeting, and providing the resolution is carried and confirmed, the directors propose to place a total sum of £7,000 to reserve. During the past 12 months the turnover has been considerably larger than in the previous year, and the increase in the number of houses and factories fitted with the Drake & Gorham standardised system of electric lighting and power has been amply maintained. The departments concerned with the sale of electrical apparatus to the trade continue to expand, and fresh agencies are constantly being arranged to take the place of those which may lapse by time or by agreement. Mr. R. Percy Sellon has retired from the board.

After mentioning the net profits, which are stated above, Mr. Drake said it was satisfactory to note that the percentage of general charges to the turnover was less during the year under review. The balance-sheet showed that the item of sundry debtors was somewhat large, but a considerable part of this sum had since been collected. The amount expended on work in hand at June 30th was less than in the previous year, but the orders received up to the end of August in the current year showed an increase compared with the corresponding period in 1902. During the period under review the company had carried out work for Lord Tankerville, Lord Crewe, Lord Mansfield, Lord Amherst of Hackney, Lord Burnham, Lady Augusta Mostyn, Sir Edward Colebrooke, Sir Wm. Boord, Captain Burns-Hartopp, Mr. Pandeli Ralli, Mr. J. P. Cross and many others, and had fitted with electric light and power several factories, including Ten Acres Mill, Manchester, with about 2,500 lights, which is acknowledged to be one of the finest examples of factory lighting and power transmission carried out in the district. At the present time they had contracts in hand for Lord Spencer, Lord Powis, Lord Yarmouth, Lord Armstrong, Lord Boyne, Lord Haddo, Captain Heywood-Lonsdale, Mr. Morgan S. Williams, the Admiralty House, Portsmouth, the Manchester Assize Courts, a large mill at Wigan and others. Several shareholders had made it their duty to keep the company informed as to likely users, but he felt that others did not appreciate the direct result that information of this sort might have on the dividends that were divisible. The advantage of standardising sets so that every individual part was the result of experience obtained elsewhere, and the cheapening of the electric light which had been

possible owing to the production of large quantities, might be regarded as essential factors in the company's success. He then formally moved the adoption of the report, the payment of an 8 per cent. dividend and the placing of £9,573 to reserve.

A special meeting followed at which a resolution was passed altering one of the Articles of Association so as to allow of the creation of a reserve fund on the same basis as other industrial companies. Mr. Drake remarked that the original clause was dictated by those interested in drawing up the prospectus, and in the financial arrangements of the company.

British Aluminium Co.

The *Financial Times* says that a circular just issued indicates that a turn for the better has occurred in the affairs of this undertaking. It will be remembered that on November 13th last the debenture holders agreed to postpone the payment of their interest until the 1st of next month, and authorised the trustees to consent, if they thought fit, to a further postponement of 12 months. It was also arranged to issue £10,000 in priority of the existing debentures. The board has now decided that there is no need for the additional time, and announces that not only will the current half-year's interest be paid on December 31st next, but that £7,500 of the £10,000 borrowed in priority to the debenture stock has been repaid. That is to say, £5,500 has been paid off since June last.

Lanchester Engine Co.

The report of the directors for the year ended July 31st last states that the net profit, after charging directors' fees, interest on debentures, depreciation on plant, tools, &c., and providing ample reserves for bad and doubtful debts, amounts to £8,667, which the directors propose to carry forward. The works have been well employed during the year. The business is now thoroughly established, and a substantial increase of turnover and profit may be expected for the current financial year. In consequence of the development of the undertaking additional capital is now required, and the directors propose to offer for subscription, at an early date, a further issue of ordinary shares, preference in allotment being reserved for the present shareholders.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to:—Charing Cross and Strand Electricity Supply Corporation, Ltd.—40,000 "City Undertaking" 4½ per cent. cumulative preference shares (1903) of £5 each, fully paid.

South London Electric Supply Corporation.—The company reports having sold during the first nine months of the current year 2,788,400 units, as against 645,000 units for the corresponding period of last year, showing a gross revenue of £27,065 as against £13,436.

British Columbia Telephones, Ltd.—The directors announce that the accounts for the year ended June 30th show that, after providing for the preference dividend, there remains a balance to provide for directors' remuneration and carry forward £1,170.

Callender's Cable and Construction Co., Ltd.—The directors have decided to pay an interim dividend of 5s. per share, at the rate of 10 per cent. per annum, on the ordinary shares. The books of the company will be closed from the 20th to the 31st inst. for the purpose of preparing such dividend.

Globe Telegraph and Trust.—Interim dividend of 2s. per share on the ordinary shares.

Western Telegraph Co., Ltd.—The directors, after transferring £35,000 to the general reserve fund and £2,000 to the maintenance ship's reserve fund, recommend a final dividend of 3s. per share, making, with previous distributions, a total dividend of 6 per cent. for the year ended June 30th, 1903, and also the payment of a bonus of 2s. per share, both free of income-tax. The balance of the account is carried forward. The register of transfers will be closed from October 27th to November 4th.

Oriental Telephone and Electric Co., Ltd.—The directors have declared an interim dividend of 3 per cent. on the ordinary shares. The transfer books will be closed from 22nd to 31st inst.

STOCKS AND SHARES.

Wednesday Evening.

Attempts to read the markets in such days as these must be left to the professors of occult science, for the conditions affecting quotations are rarely the same on the morning and the evening of the same day. Political influences have really little to do with markets that depend for their "tone" upon the financial situation of two or three of the most speculative sections. The currents that whirl quotations along are in the main financial in character, and although the Stock Exchange escaped last settlement with only a single failure—even that being challenged as a mistake—there remain only too many weak speculative accounts open which are a real menace to the quieter investment sections, such are those with which we deal.

Sharp falls in the Home Railway market came as a severe disappointment to those who have been looking at Railway stocks to take a front place in the ranks of securities that were to be bought by investors with money and confidence. Several of the Southern stocks have broken badly this week, but the only alteration in the electrical railway list is a drop of three points in City and South London Ordinary, while the Preferences are also lower. To account for this, the last unsatisfactory traffic, showing a decrease of £600, is advanced, but we have pointed out on several recent occasions that the company's supporters are holding aloof from the market. The dealers have plenty of stock on their books and know where they can get plenty more if they want it, so that every seller who comes in only puts the price lower. Should the dividend be maintained, next January the yield will certainly look fascinating, but the markets of to-day concern themselves little enough with returns upon investments.

In contradistinction to the drop in City and South London, a rise of 5s. in South London Electric shares stands out as an illustration of the fact that what is one company's meat is poison to another. The Railway's traffic decrease owes its origin to the competition of the London County Council's tramways, which are being operated by current obtained from the South London Electric Supply Corporation. The latter reports an advance in consumption of over two million units for the first nine months of the present year, and if this rate of progress were likely to prove permanent, South London shares would deserve to stand at double their current value. However, the company's contract with the L.C.C. is for too short a period to do it more than temporary good, although it may be believed that the directors will make all the financial hay they can while the County Council uses the South London Electric's current pending the completion of the new L.C.C. works.

Other changes in the Supply section are confined to a rise of ¼ in Brompton Preference, after their heavy fall of last week, while City of London Ordinary are making further progress in the downward direction, and Notting Hill shares fell ½. County of London second Debenture has lost a point. It is announced that the City of Westminster has made an arrangement for the supply of electricity for lighting purposes at 3½d. per unit with the Westminster Electric Supply Co. Westminster shares, however, are so far unchanged at 13 for the Ordinary and 6¼ the Preference.

British Aluminium 7 per cent. Preference shares have advanced a pound, and the "A" Preference are also better at 7, upon the Board's decision not to take advantage of their right to postpone payment of the Debenture interest. Obviously the company must be doing much better. General Electric Preference show a rise of 5s., and so do Brush Preference shares. Telegraph Constructions were dealt in on Tuesday last at 34 and 35. The one mark may conceivably have nothing to do with the other, but the probabilities point to somebody having got what the Stock Exchange more graphically than elegantly calls a "fat turn."

In the Telegraph market a number of properties were put *ex* dividend on the last account day, but the changes produced thereby have very little significance. Direct United States and Reuter's shares have recovered the respective deductions of 3s. and 4s., while a trio of changes in the Eastern group is due to the dividends. Anglo-American Preferred stock, allowing for its 30s. interest, marks an actual rise of ½. West India and Panama shares have declined 1s. 3d., but the 5 per cent. Debentures are 2 points to the good. None of the Telephone issues have moved on the week.

The traction department remains quietly steady, and boasts a fair amount of business. Anglo-Argentines hardened to 4⅛ buyers, but the British Electric Traction descriptions keep at their lowered levels. Perth Electric Tramways (West Australia) Debentures are changing hands about par, and London United Preference at 11⅜, the Debenture stock at 105, are both without movement. There is less doing this week in the British Columbia Electric Railway issues, but the Deferred and Preferred keep hard at 84½ and 93½ respectively. I must be immensely gratifying to nervous proprietors to note that the finding of the Alaska Tribunal has produced no slump in the stocks.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Oct. 14th.	Closing Quotations Oct. 21st.	Business done week ended Oct. 21st, 1903. Highest	Lowest
£									
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	98 —102	98 —102	100½	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2½— 3½	2½— 3½	..	..
119,700	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	70 — 80	..	..
788,840	Anglo-American Telegraph	Stock	3½%	6½%	6d%	45 — 48	45 — 48 xd	..	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	91 — 93	90 — 92	91	90½
3,105,580	Do. do. do. Deferred	Stock	5s. %	2s. %	1/-	7½— 7¾	7½— 7¾	7⅝	7½
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	5 %	6 %	4½— 5½	4½— 5½	..	..
18,333,300$	Commercial Cable	$100	8 %	8 %	8 %	145 —155	145 —155	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	90 — 93	90 — 93	..	..
16,000	Cuba Telegraph	10	4½%	4 %	6½%	7½— 8½	7½— 8½	8½	..
6,000	Do. 10 % Pref.	10	..	..	..	16½— 17½	16½— 17½	..	..
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	2½— 3½	2½— 3½	..	..
5,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	98 —102 %	98 —102 %	..	..
60,710	Direct United States Cable	20	3½%	3½%	3¾%	10¼— 10¾	10¼— 10¾ xd	10⅜	10¾
87,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	98 —101	99 —102	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	124 —129	123 —128 xd	126	124
1,955,565	Do. 8½ % Pref. Stock	100	..	..	..	90 — 93	89 — 92 xd	89⅝	89½
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	106 —109	106 —109	107½	..
300,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	11¾— 12¼	11¾— 12¼	11⅝	11⅜
320,000£	Do. 4 % Deb. Stock	Stock	..	..	..	104 —107	104 —107	104	..
300,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909	100	..	..	..	99 —102	99 —102	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	100 —103 %	100 —103 %	100	..
180,227	Globe Telegraph and Trust	10	6½%	6½%	..	8¾— 9¼	8¾— 9¼	9	8⅝
180,042	Do. do. 6 % Pref.	10	..	..	..	12¾— 13¼	12¾— 13¼	13⅛	..
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	15 %	12½%	22½— 23½	22½— 23½	..	..
62,500£	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	10%	37 — 40	37 — 40	..	..
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	98 —102	98 —102	..	..
1,983,333	National Telephone, Pref. Stock	100	5 %	5 %	6 %	99 —101	99 —101	100	99
1,966,667	Do. do. Def. Stock	100	..	..	4½%	72 — 74	72 — 74	73⅞	72
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	13⅛	13⅜
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅜— 5⅛	4⅞— 5⅛	5⅛	5
000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	93 — 95	93 — 95	94½	93½
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	101 —103	102 —104	103	102½
171,504	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6 %	⅞— 1	⅞— 1	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,889	Reuter's	8	5 %	5 %	..	6½— 7½	6½— 7½ xd	..	..
3,308	Submarine Cables Trust	Cert.	..	..	..	116 —121	114 —119 xd	..	..
58,000	United River Plate Telephone	5	7 %	7 %	7 %	5½— 6	5½— 6	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4½— 5½	4½— 5½	..	..
179,947	Do. do. 5 % Debs.	Stock	..	..	..	104 —107	104 —107	..	..
15,609	West African Telegraph, Shares	10	..	..	2 %	5 — 6	5 — 6	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	95 — 98	95 — 98	..	..
267,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	..	12 — 12½	12 — 12½	12⅝	12½
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	100 —103	100 —103	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	98 —101	98 —101	..	..
88,321	West India and Panama Telegraph	10	1½%	..	..	⅜— ½	⅜— ½	..	..
84,568	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6 — 6½	6 — 6½	..	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	3½— 4½	3½— 4½	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	98 —101	100 —103	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	3 — 4	4 — 5	4⅛	..
800,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	..	..	88 — 87	83 — 87	..	..
100,000	British Electric Traction	10	9 %	9 %	8 %	11¾— 12½	11¾— 12½	12¼	..
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	11¼— 11½	11 — 11½	11⅛	..
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	120 —123	120 —123	120½	..
100,000	British Insulated and Helsby Cables	5	15 %	10 %	10 %	6 — 6½	6 — 6½	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5½— 5⅝	5½— 5⅝	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	103 —106	103 —106	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	8 %	Nil	..	⅜— ½	⅜— ½	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	6 %	..	14/6 to 15/6	14/6 to 15/6	..	..
105,781	Brush Electrical Engineering, Ord., 1 to 105,781	2	5 %	Nil	Nil	¾— 1⅛	¾— 1⅛	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	3 %	6 %	1 — 1⅛	1⅛— 1⅜	1⅜	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	97 —100	97 —100	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	85 — 90	85 — 90	..	..
85,000	Callender's Cable Construction shares	5	15 %	20 %	15 %	11¼— 12½	11¼— 12½	..	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5½— 5¾	5½— 5¾	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	106 —110	106 —110	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	..	4 %	4 %	94 — 97	94 — 97	95½	94
494,098	Do. do. 4 % Pref. Stock	Stock	..	4 %	4 %	99 —102	99 —102	102	101½
494,998	Do. do. Def. do.	Stock	..	4 %	4 %	99 —102	99 —102	..	..
1,330,000	City and South London Railway	Stock	1½%	2 %	3½%	54 — 56	51 — 53	56	50
85,000	Crompton & Co., Nos. 1 to 85,000	8	8 %	7½%	5 %	2 — 2½	2 — 2½	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	100 —104	100 —104	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	2½%	Nil	..	0 — ¼	0 — ¼	..	..
17,139	Do. do. "A" shares, 01—017,139	5	2½%	Nil	..	1½— 2½	1½— 2½	..	..
344,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	72 — 77	72 — 77	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	76 — 81	76 — 81	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1½— 1¾	1½— 1¾	1⅛	1⅛
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	..	..	..	2½— 3	2½— 3	2⅝	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	97 —100	97 —100	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	9½— 10	9¾— 10¼	10⅛	9⅛
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	96 — 99	96 — 99	..	..
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	20 %	14 — 15	14 — 15	14⅜	14
35,000	Do. do. 4½ % Pref.	5	4½%	..	..	5 — 5½	5 — 5½	..	..
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	108 —112	108 —112	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	10 %	18½— 19½	18½— 19½	18½	..
800,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	1½%	1½%	4⅜— 5	4⅜— 5	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10¼— 10½	(10¼— 10¾	..	..
37,350	Telegraph Construction and Maintenance.	12	17½%	20 %	20 %	34 — 37	34 — 37	35	34
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	100 —103	100 —103	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3 %	3⅜%	93 — 96	93— 96	93	..

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List

Bank rate of discount 4 per cent. (September 3rd, 1903).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Oct. 14th.	Closing Quotations Oct. 21st.	Business done week ended Oct. 21st, 1903. Highest.	Lowest.
100,000	Blackheath and Greenwich Dist. Electric Light, Ord...	‡	..	..	..	⅜—⅞	⅜—⅞	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs. ..	1	..	..	..	116 —119	116 —119	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	100	..	..	..	10⅜—10⅝	10⅜—10⅝	10⅝	..
20,000	Do. do. 7 % Cum. Pref. ..	5	6 %	8 %	8 %	9⅝—10⅛	10—10⅛	..	..
50,000	Charing Cross and Strand Electricity Supply	5	9 %	10 %	10 %	9 — 9⅛	9 — 9⅛	9⅛	9¼
70,000	Do. do. do. 4½% Cum. Pref. ..	5	..	..	..	5¼— 5⅜	5¼— 5⅜	5⅜	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	..	..	..	4⅞— 5	4⅞— 5	4⅞	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	104 —106	104 —106	105⅞	..
44,436	*Chelsea Electricity Supply, Ord.	5	5½%	4 %	4½%	5¼— 6	5¼— 6	5⅜	5⅝
150,000£	Do. do. % Deb. Stock Red.	Stock	..	..	..	108 —111	108 —111	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..	10	0 %	5 %	5 %	10⅜— 10⅝	10 — 10⅛	10⅜	10⅛
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	..	..	13 — 14	13 — 14	..	..
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	122 —127	122 —127	125	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	102 —105	102 —105	..	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000..	10	4 %	4 %	4 %	7⅛— 8⅛	7⅛— 8⅛	7⅞	..
20,000	Do. do. do. 6 % Pref., 40,001—60,000..	10	..	..	..	11⅜— 12⅜	11⅜— 12⅜	11 11/16	..
400,000£	Do. do. 4½% Deb. Stock	..	..	..	..	107 —110	107 —110	108½	107
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	101 —104	100 —103	104	101⅞
50,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	6⅝— 6⅞	6⅝— 6⅞	6⅞	6⅞
80,000	Do. do. 6 % Cum. Pref.	..	..	..	..	6⅝— 6⅞	6⅝— 6⅞	6 7/16	6⅝
140,000	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	105 —108	105 —108	..	..
21,000	Kensington and Knightsbridge Electric, Ord.	5	12 %	10 %	10 %	10⅜— 11⅛	10⅜— 11⅛	..	..
90,000	Do. do. 4 % Debenture Stock ..	Stock	..	..	..	101 —104	101 —104	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	8	..	..	..	1⅜— 2⅛	1⅜— 2⅛	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	5¼— 5⅜	5¼— 5⅜	..	..
250,000£	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	100 —102	100 —102	101½	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6 %	6½%	7½%	17⅛— 18⅛	17⅛— 18⅝	..	..
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	5	..	..	..	3⅛— 3⅜	3⅛— 3⅜	..	..
290,000£	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	110 —114	110 —114	..	..
250,000£	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	97 —100	97 —100	..	..
10,852	Notting Hill Electric Lighting	10	7 %	6 %	6 %	13 — 14	13 — 14	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½— 15½	14½— 15½	15⅛	14⅜
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	..	..	..	8 — 9	8 — 9	..	..
150,000£	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	97 —100	97 —100	99	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	..	2½%	3 — 3½	3 — 3½	..	..
65,000	South London Electricity Supply, Ord.	5	..	..	1½%	3⅛— 3⅜	3⅛— 4	3⅜	3 1/16
80,000	Urban Electric Supply, Ord.	5	..	..	..	4⅛— 5⅛	4⅛— 5⅛	..	..
80,000	Do. do. 5 % Cum. Pref.	5	..	..	..	4⅜— 5	4⅜— 5	4 15/16	..
110,000	Westminster Electric Supply, Ord.	5	10½%	10½%	12 %	12¼— 13⅛	12¼— 13⅛	13	12⅜
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6⅜	6 — 6⅜	..	..

*Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, October 21st.

CHEMICALS, &c.

			Latest Price.	Week's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	5/-	..
a	,, Nitric	per cwt.	22/-	..
a	,, Oxalic	per cwt.	32/-	..
a	,, Sulphuric	per cwt.	5/6	..
a	Ammoniac, Sal	per cwt.	42/-	..
a	Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a	,, ,, ...	per ton	£30	..
a	Bleaching powder	per ton	£4 10	..
a	Bisulphide of Carbon	per ton	£15	..
a	Borax	per ton	£13	..
a	Benzole (90 %)	per gal.	7/-	..
a	,, (50/90 %)	per gal.	5/6	..
a	Copper Sulphate	per ton	£20	..
a	Lead, Nitrate	per ton	£24	..
a	,, White Sugar	per ton	£31	..
a	,, Peroxide	per ton	£27 10	..
a	Methylated Spirit	per gal.	2/6	..
a	Naphtha, Solvent (90% at 160° C).	per gal.	5/6	..
a	Potash, Bichromate, in casks ..	per lb.	8d.	..
a	,, Caustic (75/80%)	per ton	£24	..
a	,, Bisulphate	per ton	£35	..
a	Shellac	per cwt.	200/-	12/- inc.
a	Sulphate of Magnesia	per ton	£4 10	..
a	Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a	,, Recovered	per ton	£5 10	..
a	,, Lump	per ton	£5	..
a	Soda. Caustic (white 70 %) ..	per ton	£10 15	..
a	,, Crystals	per ton	£3	..
a	,, Bichromate, casks.. ..	per lb.	2½d.	..

METALS, &c.

b	Aluminium Ingots, in ton lots ..	per ton	£130	..
b	,, Wire, in ton lots ..	per ton	£168	..
b	,, Sheet, in ton lots ..	per ton	£166	..
p	Babbitt's metal ingots	per ton	£43 to £130	£5 dec.
c	Brass (rolled metal 2' to 12') basis	per lb.	6¾d.	¼d. dec.
c	,, Tube (brazed)	per lb.	8¼d.	¼d. dec.
c	,, ,, (solid drawn).. ..	per lb.	7⅞d.	¼d. dec.
c	,, Wire, basis..	per lb.	7d.	¼d. dec.
c	Copper Tubes (brazed)	per lb.	8¾d.	..
c	,, ,, (solid drawn) ..	per lb.	9d.	..
g	Copper Bars (best selected ..	per ton	£68	..

METALS, &c. (*continued*).

			Latest Price.	Week's Inc. or Dec.
g	Copper Sheet	per ton	£68	..
g	,, Rod	per ton	£68	..
e	,, (Electrolytic) Bars ..	per ton	£65	..
e	,, ,, Sheets ..	per ton	£75	..
e	,, ,, Rod ..	per ton	£67	..
e	,, ,, H.C. Wire	per lb.	8d.	..
f	Ebonite Rod	per lb.	3/3	..
f	,, Sheet	per lb.	3/-	..
n	German Silver Wire	per lb.	1/6	..
h	Gutta-percha fine	per lb.	8/-	..
h	India-rubber, Para fine	per lb.	4/3 to 4/5	inc.
i	Iron, Charcoal Sheets	per ton	£18	..
i	,, Pig (Cleveland warrants)	per ton	43/6	..
i	,, Forgings, according to size	per ton	From £11	..
i	,, Scrap, heavy	per ton	47/6 to 50/-	..
i	,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g	Lead, English Ingot	per ton	£11 5 to £11 7 6	..
g	,, ,, Sheet	per ton	£13	..
m	Manganin Wire No. 28	per lb.	8/-	..
g	Mercury	per bot.	£8 7 6	..
d	Mica (in original cases) small ..	per lb.	4d. to 1/6	..
d	,, ,, ,, medium	per lb.	2/6 to 3/9	..
d	,, ,, ,, large ..	per lb.	4/- to 7/9	..
p	Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p	,, rolled bars & rods	per lb.	1/- to 1/3	1d. dec.
p	,, ,, strip & sheet	per lb.	From 1/1	1d. dec.
o	Platinum	per oz.	£4	..
p	Silicium Bronze Wire	per lb.	9d. to 11d.	1d. dec.
i	Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i	,, ,, in bars		£15 to £40	..
g	Tin, Block	per ton	£119 to £121	£1 to £2 inc.
g	,, Foil	per lb.	1/6	..
n	,, Wire, Nos. 1 to 16	per lb.	1/6	..
p	White Anti-friction Metals— "White Ant" brand ..	per ton	£42 to £62	£3 dec.
j	Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j	,, 6 lea. Flax	per lb.	5¾d.	..
j	,, 8 ply 10 lbs. Russian ..	per lb.	4⅛d.	..
j	,, 10 lbs. Russian, single ..	per lb.	4¼d.	..
j	,, 180 lbs. Jute rove ..	per ton	£11	..
k	Zinc, Sh't (Vieille Montagne bnd.)	per ton	£23 15	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakespeare; *h* Edward Hill & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RECEIPTS.

	Locality.	Week ending	Receipts for the week. £	£*	Total to date. £	£*	Miles open.	*
	Aberdeen	Oct. 17	1,212	+287	26,082	+ 3,827	10	—
	Birmingham	,, 17	5,133	— 97	213,668	+ 9,095	—	—
	Bournemouth	,, 14	1,000	—	—	—	10½	—
	Blackburn	—	—	—	—	—	12½	+1½
	Blackpool	,, 15	535	+ 28	34,484	— 231	8½	—
	Blackpool and Fleetwood	,, 17	317	+ 11	18,721	— 140	7½	—
	Blackpool and Lytham ..	,, 15	382	+275	12,309	+ 6,219	—	—
	Bolton	,, 18	1,803	+281	54,747	+ 7,149	25	—
	Bradford	—	—	—	—	—	41	+4
	Brighton	,, 18	594	+ 92	41,872	—	6½	—
	Bristol	,, 16	5,048	+242	—	—	28	—
	Burnley	,, 17	805	+ 87	—	—	7½	—
	Barnsley District	,, 9	182	—	7,347	—	4½	—
	Devonport	,, 9	552	+144	18,491	+ 811	5	—
	Dudley—Stourbridge..	,, 9	841	+ 94	34,169	+ 3,879	18⅝	—
	Gateshead	,, 9	1,027	+154	35,260	+ 4,862	10½	+ ¾
	Gravesend—Northfleet	,, 9	276	+ 65	9,905	+ 945	3½	—
	Greenock—Pt. Glasgow	,, 9	515	+ 13	22,365	+ 1,705	7½	—
	Hartlepool	,, 9	283	+ 65	11,083	+ 567	6½	+2
	Kidderminster	,, 9	120	— 1	5,354	+ 185	4½	—
	Merthyr	,, 9	312	+ 19	8,055	— 206	3	—
	Middleton	,, 9	280	+ 42	13,275	+ 1,653	8½	—
	Oldham—Ashton ..	,, 9	571	+ 18	23,961	+ 1,543	8	—
	Peterborough	,, 9	244	—	6,125	—	—	—
	Poole	,, 9	298	+ 56	12,646	+ 1,904	8½	—
	Potteries	,, 9	1,738	+112	68,456	+ 3,418	28½	—
	Rothesay..	,, 9	60	— 7	6,544	+ 1,612	2½	—
	Sheerness	,, 7	73	—	2,460	—	2½	—
	Southport	,, 9	920	+ 89	18,089	+ 2,999	5½	—
	South Staffordshire ..	Oct. 9	927	+194	36,505	+ 5,463	21½	−½
	Swansea	,, 9	517	+ 56	21,214	+ 1,773	5½	—
	Taunton	,, 9	56	—	2,525	— 196	1½	+1½
	Tynemouth	,, 9	279	— 19	13,285	+ 868	3½	—
	Weston-super-Mare..	,, 7	62	— 11	5,364	— 482	2½	+2½
	Wolverhampton Dist.	,, 9	393	+ 92	15,935	+ 7,971	10½	+8
	Wrexham	,, 9	131	—	3,967	—	—	—
	Yorks. Woollen Dist..	,, 9	479	—	12,228	—	6	—
	Cardiff	,, 10	2 015	+480	56,846	+16,546	14	—
	Chatham & District Co.	,, 8	629	+ 86	21,802	+12,894	8·53	—
	Dover	,, 17	208	+ 4	9,534	+ 113	3	—
	Dublin	,, 16	4,883	— 37	86,579	+ 7,378	46½	+ ½
	East Ham	,, 17	589	+ 96	20,163	+ 6,019	5	+ ½
	Glasgow	,, 17	14,082	+1391	274,527	+30,410	66	+ 9
	Hull	,, 17	2,559	+ 64	54,393	+ 2,644	11	+ 1
	Ilkeston	,, 14	142	—	—	—	4	—
	Isle of Thanet	,, 17	395	— 33	30,421	— 1,534	10½	—
	Leeds	,, 17	5,138	+ 73	164,631	+10,191	41	—
	Liverpool	,, 10	10,474	+ 601	413,847	+18,756	103	—
	Manchester	,, 17	11,455	+6146	344,042	+210,784	72	—
	Newcastle	,, 17	3,498	+380	—	—	17	—
	Portsmouth	,, 17	1,472	+ 54	—	—	29	—
	Salford	—	—	—	—	—	30	—
	Southampton	,, 15	974	— 16	—	—	9	—
	Sunderland	,, 18	1,125	+ 45	37,431	+ 1,909	20	+3
	Central London Railway	,, 17	6,443	—528	97,583	— 5,084	6	—
	City and S. London Ry.	,, 18	2,761	—512	40,084	— 5,814	6½	—
	Dublin and Lucan Elwy.	,, 18	116	+ 7	2,281	+ 168	6½	—
	Liverpool Overhead Ry.	,, 18	1,594	+ 74	27,133	+ 1,333	6	—

British Elec. Trac. Co. / B.E.T. Co.

* Compared with the corresponding period of 1902.

THE JUNIOR INSTITUTION OF ENGINEERS: SUMMER MEETING.

THE summer meeting of the "Junior Engineers" this year centred around Sheffield and the Peak District, and quite a considerable number of members were attracted by the excellent programme provided. It happily combined some of the finest and most interesting spectacles in the science of engineering with those of surpassing natural beauty for which the county of Derbyshire is so famed.

Members from London travelled down by the Midland route to Bakewell, and thence drove to Baslow, the Grand Hotel becoming headquarters for the week. The journeys into the city of steel were made by road through charming scenery, a different course being taken on each of the three days spent there.

A fitting opening of the week's engagements was the civic welcome at the Town Hall, Sheffield, on August 17th. The Lord Mayor, the Right Hon. J. Wycliffe Wilson, J.P., in a few appropriate sentences expressed the pleasure felt on behalf of the Corporation and citizens in greeting the Institution on its first visit to Sheffield. He trusted it would prove of the greatest possible benefit in every way. The chairman of the Institution, Mr. Kenneth Gray, having replied, the members at once re-entered the carriages and were driven to Attercliffe to visit Messrs. Davy Brothers' works, under the guidance of Mr. Crowe and other gentlemen. Established for upwards of three-quarters of a century, these works comprise three departments:—(1) Engineering; (2) boiler making; (3) rolling mills. All classes of machinery, including the very heaviest types, for iron and steel works and collieries, are produced. Steam hammers, particularly those of the quick self-acting tilting type for the Sheffield steel trade have always been a speciality; those for stamping processes in small-arms factories are also turned out. A number of heavy hydraulic forging presses have been constructed, one of 3,000 tons having been recently supplied to Messrs. John Brown & Co. A novelty brought under the notice of the party consisted of a very quick-acting press devised by Messrs. Crowe & Davy. The three-throw pumps used for working it can be driven either by steam or electricity, and with these advantages the press is suitable for very much smaller powers than have hitherto been usual for hydraulic presseess. A press of 300 tons capacity was seen at work

Nearing completion was shown a complete armour-plate mill for the Imperial Japanese Government, the set of vertical three-cylinder reversing engines being of 12,000 H.P. The engines and mill gearing, including the pinion housings and coupling spindles, are built in a very massive bed, forming an unusually compact and self-contained arrangement. The rolls, of forged steel, are 48-in. diameter × 13 ft. 6 in. long between the necks, and will be mounted in steel housings. The mill is similar to one constructed by the firm a few years ago for Sir W. G. Armstrong, Whitworth and Co., and is by far the most powerful armour-plate mill that has ever been constructed, being capable of rolling a 40 or 50-ton hard chrome steel ingot, into a plate in about 15 minutes. Another notable piece of work in course of erection at Messrs. Davy Bros. was an imposing set of vertical blowing engines for blast furnaces, built to the order of Messrs. William Sandford for Australia. The air cylinder is 96 in. in diameter, the steam cylinder 48 in., the air pressure required being comparatively low. Other work in hand in the engineering department included a 30-cwt. buffer-stamping hammer, a 15-cwt. stamping hammer, a complete rolling-mill plant for a Sheffield firm, and a steel converter.

Until recently the size of the Lancashire boiler in most general use in the district has been 8 ft. diameter × 30 ft. long for 100 to 120 lbs. per sq. in. pressure. Now, boilers 8 ft. 6 in. and 9 ft. diameter × 30 ft. long, and for pressures up to 160 lbs. are supplied frequently. Where spare is confined a large number of marine-type boilers, both of the ordinary internal firebox and of the dry-back type up to 12 ft. 6 in. diameter, have been constructed. For Lancashire boilers the firm have adopted a type of coned flue which, whilst possessing the full advantages of the corrugated flue in additional steaming capacity, is supplied at just one-fifth of the additional cost of the corrugated flue. It can also be cleaned and repaired with greater facility. Ellis & Eave's system of heated induced draught in connection with Cornish and Lancashire boilers has been taken up by Messrs. Davy. By its application it is claimed that as much as 40 per cent. increase of steaming capacity can be obtained and a saving of from 15 to 25 per cent. in coal consumption.

On leaving Attercliffe, the members went on to Tinsley to visit the East Hecla Works of Messrs. Hadfield's Steel Foundry Co. They were received by Col. Sir Howard Vincent, M.P. (director), Mr. W. Dixon (the manager), Mr. P. B. Brown and other officials. A photograph of the party having been taken for subsequent presentation to each member as a souvenir of the visit, an excellent luncheon was served in one of the sheds which had been specially decorated for the occasion in honour of the visitors. Col. Sir H. Vincent presided, and in responding to the vote of thanks passed to his company for the warmth of their welcome, made one of his characteristic speeches, full of useful suggestions for the consideration of his engineering audience, who appeared to be much impressed by them.

In going round the works, the setting-out, building and lay-out floor of the tramway construction department was first seen. It is about 6 acres in extent, and is supplied with all the latest plant requisite for the bending, cutting, punching and drilling of the rails for their proper position in the lay-out. The bending is done by special power presses, and all the tools are electrically driven. There was evidently an abundance of work on order; double junctions with iron bound crossings for Manchester, Chatham and Leicester; car-shed work for Burnley, and special junctions for Stalybridge. Attention was directed to the junctions for Bradford and Stalybridge, the points, crossings and curved rails for which are all made of Hadfield's "Era" manganese steel. In the foundry, which is the largest in the world, all the cranes, both overhead and jib, are actuated electrically. The castings in hand included special work for the L.C.C. tramways, locomotive wheels, hydraulic press crosshead, anchors, dynamo and motor work, gearing, car wheels, colliery tub wheels, railway carriage and wagon castings, and conveyor and elevator links. Five complete crossovers were seen in process of construction, the visitors examining very closely the intricacies of this special work. The generating station, containing five large engines for the supply of electric power to the works, was then visited, followed by the annealing and grinding shops, where manganese steel points were being straightened in the press cold, and the smiths' shop, in which manganese steel dredger pins of various sizes were being forged and colliery wheels and axles made, the output of the latter being 1,200 to 1,500 sets per week. Colliery tubs of different designs were also seen in course of manufacture. In the machine shop notable features were the cylinders and locomotive wheel centres, a dredger tumbler 10 tons in weight, two cast-steel frames for a 24 × 19-in. stone breaker. Numerous motor and dynamo castings were also being machined. To practically demonstrate the severely rough character of the work which the jaws of the stone breakers have to withstand, several machines were shown under power, masticating chunks of hard stone quite as readily as a home-made sandwich would be negotiated by the human jaw. Messrs. Hadfield & Jacks' gyratory crusher was likewise exhibited. The track shop was then entered, where points of all descriptions used for electric tramway work were shown, including cast-steel points with "Era" manganese steel tongues; also others, from 9 ft. to 13 ft. long, made throughout of that material, with and without inserts; and "Era" manganese steel crossings of both the frog and leg type. The electrically driven tools for grinding the castings were seen, and shortly afterwards the visit concluded.

Tuesday's programme afforded some relaxation from engineering technicalities, inasmuch as the day was devoted to an excursion for the inspection of Haddon Hall and Chatsworth House. The keen interest which the members evinced in both edifices and their contents showed that engineers are not incapable of appreciating the artistic, so many beautiful examples of which were disclosed in the course of these visits.

The works of Messrs. Charles Cammell & Co. were opened to the Institution next morning, and here again the cordiality of the welcome extended to the visitors was very pronounced. After the party had been photographed again, the *pièce de resistance* was at once presented. This consisted of the rolling of a huge armour plate which had been specially got ready in time for the arrival of the members. The plate, weighing 25 tons, and intended for H.M.S. *Hindustan*, was drawn from the furnace and gradually reduced in the rolls to the required thickness. The subsequent treatment which the plates have to undergo was also shown and fully explained as the members were conducted round the works by Mr. F. C. Fairholme, Mr. Wood, Mr. Hartley, and others of the staff. The machine and erecting shops were seen, large casemates and gun shields being in process of manufacture there. In the electric generating station a fine plant, which has only lately been installed, was inspected. In addition to lighting the works it is employed to supply power to many of the machines, notably the self-contained emery grinders used for finishing the edges of the armour plates, &c., file cutting by machinery, tool-steel rolling, general forging, crucible steel melting, ordnance, marine, locomotive, dynamo and other castings, were other features brought under the notice of the visitors, the concluding item being the presentation to each of them of a penknife as a *memento* of the great Cyclops Works. Carriages were then requisitioned, the party soon afterwards assembling at the Royal Victoria Hotel in acceptance of an invitation to luncheon which had been kindly issued by Messrs. Cammell.

Mr. Fairholme presided at this function, and at the termination there were a few brief speeches. Mr. Wood proposed "Success to the Junior Institution of Engineers," which was responded to by Mr. Kenneth Gray, who remarked that at a time when they heard so much about American and German competition in all fields of commercial enterprise, it was very gratifying to see in Sheffield works of such magnitude and importance as Messrs. Cammell's, and capable of producing material superior to that of any other country in the world. The recognition which the Institution had during its visit received from those holding high positions in commercial and industrial activity would be a great encouragement to young engineers. Mr. Samuel Cutler, jun., vice-chairman of the Institution, then proposed "Continued Prosperity to Messrs. Cammell & Co.," thanking them for all they had done in receiving the Institution that day. Mr. Fairholme acknowledged the toast, and in the course of his speech, said that the members had had the opportunity of seeing something of the company's work in connection with the arts of war. He was sorry that time did not allow of them being shown what their work was in connection with the arts of peace, but they could not see everything in a day. He went on to refer to the advantages arising from a closer co-operation between engineers and manufacturers. Not only were industries benefited by it—the profession at large were the gainers. Some cogent observations on the good work being done by the Engineering Standards Committee brought his remarks to a close, and after an appreciative farewell to Messrs. Cammell's representatives, the members made their way to Messrs. James Dixon & Sons' silver and electro-plate works, Cornish Place.

Here they were met by Mr. J. Wallis Dixon who, assisted by Mr. James Dixon and Mr. E. D. Fawcett, directed the party over the extensive establishment. There are three casting shops, one for nickel silver, one for Britannia metal, and the third for small castings. After passing through the rolls the sheets are cut by double-acting shears into the size required for producing the various articles. Spoons and forks are first cut into blanks by self-acting machines, and then pass on to the stamp shop in which were seen at work both steam and friction stamps. A pressure of 100 tons is given by one of the steam presses. Entrée dishes were being made, shaped out of the flat metal by repeated stampings on a steel die, also the two halves of teapots, &c., afterwards brazed together. Spoons, forks, &c., were also in hand. The spinners shops, hand hammering and filing, making up, buffing, polishing and burnishing shops were full of interest, and particular attention was given to the electro-plating room and the electric installation in connection. After appropriately partaking of afternoon tea in a service manufactured at the works, and heartily thanking Messrs. Dixon for the interesting afternoon which had been spent, the members left, the majority returning to Baslow.

Thursday was occupied by an excursion to Castleton, where are the celebrated caves, the Mecca of visitors from all parts of the world. The Speedwell was navigated successfully, and afterwards the descent and examination was made of the Blue John Cave, where the stone from which the cave takes its name is mined to a very limited extent, the output being rigidly restricted to no more than 3 tons per annum, the cave being absolutely the only source of supply for this rare and delicately-coloured transparent mineral. Raining incessantly throughout the day, the caves certainly gave shelter to the members for a time, and were most decidedly well worth a place in the programme.

The Toledo Works of Messrs. John Henry Andrew & Co. were visited first on the following morning, the party being hospitably received on their arrival after their drive from Baslow. Mr. J. L. Potts, one of the directors, assured them of the pleasure which the arrangement of the visit had given his company. Under his guidance, assisted by his son and others, the members were then shown over the works, the crucible melting furnaces and pot making departments being seen at the commencement of the tour. The clay was first kneaded by the feet of the operative, and after a quantity sufficient for one pot had been weighed off, it was further kneaded by hand on an iron plate, and then passed on to the potter, who placed it in an iron mould, the interior surface of which corresponded with the outer surface of the crucible. An iron punch the exact form of the inside of the pot was then inserted and hammered in by a wooden maul, thus correctly shaping the pot. The punch being withdrawn, the pot was ready for drying and baking, which were done by the waste heat from the furnaces. It was afterwards annealed in a special furnace, and was then ready for use after a bottom and lid made from the same clay had been fitted. The turning out of large crucible steel ingots was witnessed, and the hammering department was seen, hexagonal, octagonal and other sections being in process of forging for working into miners' drills, &c. In the steel warehouse were noticed large quantities of the finished steel ready for export to South Africa, Australia, China, Japan and other foreign parts. In the spring making department, numerous springs of every shape and variety for omnibus, carriage and motor-car construction were in hand. The manufacture of the latter appear to have only comparatively recently been seriously taken up, the results giving great satisfaction. The method of testing the springs was shown, and the rolling mills were next visited, where the steel ingots after reheating were seen in process of rolling into various sections, including that for spindle steel for cotton, flax and such like machinery. Of this steel Messrs. Andrew are the largest manufacturers in the kingdom. Shot and shell steel, rifle barrel and bullet steel are also produced. Wire for the manufacture of steel ropes was being run out at one of the mills. Piano wire is also made. The 10-ton Siemens-Martin steel furnaces, of which there are four, were included in the inspection. The ingots from these are hammered into blooms to 3 in. square, varying in weight from 60 to 250 lbs. They are reheated and reduced by passing through a series of rolls in a three-high cogging mill into rough billets 1½ in. square, and then passed to the finishing or wire mill and rolled into rods ranging from ½ in. diameter down to 6 B.W.G. The smithy and turnery for works repairs were visited, the rolls required in the mills being turned here. They are usually of chilled iron or steel made on the works. The inspection of the department in which hammers, mauls, sledges, picks, mining chisels and other similar tools are produced formed the conclusion to a highly interesting morning, the distribution to the members of Toledo blades in commemoration of it forming a pleasing *finale*. The Institution's acknowledgments having been warmly expressed by the chairman, the party repaired to the Royal Victoria Hotel for luncheon.

In the afternoon the members visited the Suffolk Works, carried on in the name of Messrs. Thomas Turner & Co., whose business was taken over in 1893 by the present proprietors, Mr. A. J. Hobson, who is the Master Cutler this year, and Mr. W. Hobson. Upwards of 1,000 hands are engaged at the works. The Master Cutler welcomed the visitors as they entered, and they were then divided into groups and made a tour of the works with the general manager, Mr. Nathaniel Somerset, and his colleagues as guides. The impressing feature was the large amount of work which was being executed without the aid of machinery. In a very choicely got up brochure entitled "Handicrafts that Survive," a copy of which the firm had considerately presented to each member, was set forth a detailed and illustrated account of the various operations carried on. Knives, razors, scissors and every other class of cutlery were seen in all processes of manufacture. The principal raw material used is blister steel, produced from bars of the best Swedish charcoal iron, which is most free from sulphur, phosphorus and other impurities. The forging of the blades and the grinding, particularly the hollow grinding, was observed with great interest, as were also the other operations through which the articles had to pass before they attained the excellence and perfection of finish on which the firm so justly prides itself, and which was exemplified in the neat and serviceable specimen which it was the good fortune of every member who visited the works to take away with him. At the conclusion of the visit light refreshments were served, when the opportunity was taken to convey to the Master Cutler the sense of the members' gratitude for the courtesy extended them that afternoon. Mr. Hobson suitably replied, and the party proceeded to Corporation Street, to visit the works of Messrs. Mellowes & Co.

The product of this firm is the well-known "Eclipse" glazing, water-tight, imperishable and dust-proof. The frames are made of steel bars covered with a substantial soft tin-lead metal casing formed with a groove at each side into which the glass is inserted, no putty being used, the lead bedding close to the glass throughout. The steel-bar covering machine, the shearing and other machinery was shown running. There was a large quantity of work in hand, some of the most recent and important commissions being for the new Midland railway station at Sheffield and the re-glazing of the Crystal Palace roof. Mr. F. W. Mellowes and Mr. Ernest King, who was also acting as honorary local secretary of the meeting, explained the construction and working of the various machines, and how the finished glazing was put together and erected. This visit constituted the last of the series, and with expressions of thanks to Messrs. Mellowes for all their attention, the members departed.

In the evening the summer dinner of the Institution took place at the Royal Victoria Hotel, the chairman, Mr. Kenneth Gray, presiding. The Master Cutler, the Deputy Lord Mayor, Alderman George Senior, J.P., representatives of the various works visited during the week, and other guests, were present, and there was a good muster of the members, the attendance of local members indicating the growth of the society in the Yorkshire district. After the loyal toasts had been honoured, the chairman proposed "The City and Corporation of Sheffield," acknowledged by Alderman Senior. "Sheffield Industries" was given by Mr. W. J. Tennant, past chairman, and was responded to by the Master Cutler, whose election as a Vice-President of the Institution was announced at the dinner. Mr. R. Marshall proposed "The Firms who have entertained us," and Mr. B. P. Brown (Messrs. Hadfield's), Mr. F. J. Maw (Messrs. Cammell's), and Mr. J. L. Potts (Messrs. Andrew) replied. "The Health of the Institution" was proposed by Mr. F. W. Mellowes, and acknowledged by the chairman. "Our Guests," submitted by Mr. L. F. Peyrecave, was replied to by Mr. R. H. Dunbar and Mr. H. W. Pawson. The concluding toasts were "Our Honorary Local Secretary," by the secretary (Mr. W. T. Dunn), and "The Chairman," by the Master Cutler, which Mr. Gray and Mr. King respectively acknowledged.

An illuminated vote of thanks was presented to Mr. King in recognition of his valuable services as honorary local secretary. Great credit is due to him for planning all the arrangements, which were admirably conceived and carried through without a hitch, thus adding one more to the always successful summer meetings organised by the youngest of our technical societies, the progress of which we shall continue to watch with increasing interest.

THE BRITISH ASSOCIATION, SOUTHPORT, 1903.

EXPERIMENTS FOR IMPROVING THE CONSTRUCTION OF PRACTICAL STANDARDS FOR ELECTRICAL MEASUREMENTS.

(*Read before Section A.*)

(*Concluded from page* 638.)

APPENDIX III.

On the Platinum Thermometers of the British Association.

By J. A. Harker, D.Sc.

(*From the National Physical Laboratory.*)

The four platinum thermometers numbered BA_1 to BA_4, with which this appendix chiefly deals, were constructed at the National Physical Laboratory in August, 1902. The wire used for the "bulbs" is approximately ·006 in. (·15 mm.) diameter, and for the leads ·020 in. (·5 mm.).

After ascertaining approximately the length of wire necessary to give a fundamental interval of 1 ohm, the proper amount for the four thermometers was cut off from the stock reel, and heated in one piece to moderate redness (800° C.) electrically when supported approximately horizontal. The platinum "lead" wires, which were of the same quality of pure metal as the finer "bulb" wire, were then measured off and the pairs assigned to each thermometer accurately matched. After a preliminary anneal in an oxidising atmosphere at a bright red heat, one of each of these pairs was looped upon itself to form the compensator, and the other cut in half for attachment to the ends of the "bulb" wire. Several kinds of mica from different sources were tested as to their suitability for use as insulating material for the frame and washers to support the

wires, and it was found that considerable discrimination was necessary in the selection of the mica for this purpose. Certain qualities which were colourless before heating became on exposure to only 800° to 850° of a marked brown tint, and it was found in one case this was due to organic material having been used to fasten together several sheets to build up the necessary thickness, the carbonaceous matter leading to a fall in insulating power several hundred degrees below the temperature at which good mica begins to appreciably conduct, which ought not to be lower than 1,150° C. In another case, a specimen which showed the characteristic silvery white lustre after several hours' exposure to 1,100° C., had lost so much of its mechanical strength as to be almost unusable. A specimen which before heating was of slightly green tint was finally selected, and of this the whole of the mica frames and washers were constructed. The copper wires connecting the platinum leads to the fusible-metal caps were silver-soldered to the platinum, and for extra safety against possible strain the wires were screwed into the caps as well as hard soldered. In order to be protected as far as possible from unsymmetrical heating, which often gives rise to thermo-electric effects in certain types of thermometer, these joints between platinum and copper are arranged so as to be well inside the brass tube into which the glass or porcelain protection tube is fastened. The thermometer heads are of ebonite, and are of the design described by Harker and Chappuis in *Phil. Trans.* 194, p. 52. They are practically airtight, and will stand vacuum or pressure for a considerable time. By a small tap, which is generally kept closed, communication can be made with a convenient apparatus for exhausting and letting in dry air while the thermometer is suitably heated. The effect of electric leakage in lowering the apparent resistance of a platinum thermometer when damp is much more easily traced on thermometers of 5 or 10 ohms F1 than on the usual 1 ohm pattern used for high temperatures. With the thermometers here described, having the enclosed form of head, none of the determinations of fixed points have been found to be vitiated by moisture, care having been taken not to expose any portion of the interior to prolonged contact with the outside air, after once being thoroughly dried out at a high temperature.

The mica cross, having serrated edges with teeth of 1 mm. pitch, being attached to the leads and compensator, the joints between the "bulb" wire are made in the strongly oxidising flame of a very small oxy-coal-gas blowpipe without admixture of foreign material of any description. Autogenous soldering of this kind is not very difficult, even for very fine wires, and is essential if the thermometers are intended for use to the highest temperatures safely measurable, namely, 1,150° C., as the copper and silver contained in any solder which might be employed give off vapour sufficient to injuriously affect the platinum on prolonged exposure to temperature considerably below this. The "bulb" wire when fastened to the leads is then wound, not too tightly, upon the mica frame, and the thermometer is then inserted into its protecting tube of very thin glass or of porcelain, which must be glazed on the exterior, and if the thermometer is not intended for use above about 1,000° C., may with advantage be glazed both inside and out. A measurement is then taken of the fundamental interval, with a view to ascertain the change on annealing, which is then carried out by heating two or three times to about 1,000° for several hours, with slow cooling, the thermometers with glass tubes being temporarily placed in porcelain ones for this purpose. The fundamental interval is then taken again, and if this is not considered sufficiently near the desired value, it can be lowered by cutting out the required amount from the looped end of the wire and re-fusing, or raised by stretching judiciously with platinum-tipped pliers the lowest few inches of the wire, which is unwound for the purpose. Care must be taken after each re-adjustment to remove any possible new strains introduced by a thorough re-anneal before measurement. In the absence of definite evidence in its favour, it was not deemed desirable for this first set of thermometers to heat the wire for some hours electrically to 1,400° or 1,500° C., as is usual in careful work with wires of platinum and the allied metals employed for thermo-junctions.

After the final adjustment of the F1 and final anneal, systematic observations of the zero, steam and sulphur points of the four thermometers were made from time to time with the resistance-box described in the text. A new calibration of the box coils and bridge wire was made in February, 1903, and the values of the relation $\frac{R^1}{R_0}$ and of the δ found since that date are tabulated for each thermometer. From this summary it will be seen that there appears to be a small but systematic difference between thermometers 1 and 3 on the one hand, and 2 and 4 on the other, this being noticeable both on the values of $\frac{R^1}{R_0}$ and of δ.

The values of $\frac{R^1}{R_0}$ vary from 1·38709 in BA_1 to 1·38881 in BA_2,

the mean of the four being 1·38786, which is a little higher than the mean value found by Chree for the group of seven thermometers studied by him, namely, 1·38702.

The mean values of the δ are:—

	δ	Departure from mean.
BA_3	1·5124	... +·0110
BA_1	1·5083	... +·0069
BA_4	1·4935	... −·0079
BA_2	1·4912	... −·0192
Mean δ= ...	1·5014	... —

The mean δ of the six thermometers observed in sulphur in Chree's experiments was 1·503, the maximum being 1·509 and the minimum 1·498. The mean values of the R_0, R_1, and F1 for the period from February 12th to August 31st are also given. In view of the uncertainties in the measurement of the temperature of the box-coils, which are of platinum silver not immersed in a liquid, and also of small irregularities in the behaviour of the plug-contacts, the experiments afford no certain evidence of systematic change in any of the thermometers, unless it be a small rise in the fundamental coefficient and corresponding fall in the δ of BA_1.

Thermometer BA_2, which was heated about fifty times during November, 1902, in electric furnaces up to 1,050°, and again during April and May, 1903, to similar temperatures for prolonged periods, appears to be hardly perceptibly affected by it, no certain change of F1 occurring during the period February 12th to August 18th covered by the later experiments, and certainly no variation of the zero of ·1° C.

To see if the small lack of homogeneity of the wire as shown by the properties of the different thermometers was due to the treatment it had received during the successive adjustments of F1, a new thermometer, named BA_7, was made up of wire taken from the inner end of the same reel as the other six. No attempt was made at adjustment of its F1, which was found after thorough annealing to be 100·022 box units.

The δ was found to be 1·506, an intermediate value. The wire was then unwound from the mica frame and suspended freely in air between the ends of the leads, and a current of 2½ amperes, which was sufficient to maintain it at about 1,400° C., passed for about two hours.

Owing to the volatilisation of a considerable quantity of platinum from the wire, a large increase in the F1 was found, as was expected, but the δ remained unchanged, though a rise in $\frac{R^1}{R_0}$ was recorded amounting to 1 part in 1,000.

In order to make certain that the differences observed were not due to defective insulation in the thermometers, the insulation resistance between the PP and CC leads of each of the thermometers was measured by a direct deflection method, and found to be in no case less than 700,000 ohms at any temperature between 0° and 1,000° for BA_1 and BA_2, and 0° and 500° for BA_3 and BA_4. Some experiments were also made on an imitation platinum thermometer having its coil wound on mica of standard quality, but cut at the lower end into two parts.

Although the insulation from one part to another was practically infinite at all temperatures, when only platinum and mica were present in the heated part of the porcelain tube, the introduction of a small piece of clean copper wire into the hot space near the bulb was sufficient after some time to lower the insulation, even at only about 800° C., to a few thousand ohms. The cause of the differences between the individual thermometers does not, therefore, appear to be leakage.

Neither does the cause of the small differences in values of δ found lie in the method of taking the sulphur point, as the same apparatus was used in the same way for all the experiments. The sulphur is now boiled in an arrangement similar to Callendar and Griffiths's well-known pattern, except that, to avoid the necessity of removing the tube at each reheat after the sulphur has crystallised, the glass boiling tube is replaced by one of thin weldless steel, brazed with spelter into a rather wider end-piece of thick iron tubing, which is exposed to the direct flame of the large bunsen used for heating. The level of the liquid sulphur is always maintained at least 2 in. above the bottom plate of the apparatus, and the upper level of the vapour to a definite position, which can be seen through mica windows in the upper part of the neck. Under these conditions no measureable superheating of the vapour has ever been observed, and a comparison of the sulphur points obtained with this form of apparatus with those got in the older one, with glass boiling-tube, reveals no measurable systematic difference.

For the boiling-point of sulphur under normal pressure in latitude 45° Callendar and Griffiths's old value, 444·53° C., has been retained, as was also the figure deduced by them from Regnault's experiments for $\frac{dt}{dp}$ for sulphur, namely, ·082° C. per mm., although it has been shown independently, by Chree and by Harker and Chappuis, that this value for the variation is considerably too small. It is hoped that a redetermination of this constant for pressures between 700 and 800 mm. will shortly be undertaken in the thermometric laboratory.

BA_1.

Date.	δ	$\frac{R_1}{R_0}$	Difference of $\frac{R}{R_0}$ from mean.
Feb. 6th, 1903	1·514	1·38688	− ·00021
„ 23rd, „	1·505	1·38702	− ·00007
Aug. 7th, „	1·506	1·38708	− ·00001
„ 25th, „	1·505	1·38712	+ ·00003
„ 26th, „	1·514	1·38722	+ ·00013
„ 31st, „	1·506	1·38722	+ ·00013
	Mean 1·5083	1·38709	

Mean Value of Constants.

R_0	R_1	F1	δ	$\frac{R_1}{R_0}$
257·905	357·736	99·831	1·5083	1·38709

BA$_2$.

Date.	δ	$\frac{R_1}{R_0}$	Difference of $\frac{R}{R_0}$ from mean.
Feb. 12th, 1903	1·484	1·38867	— ·00014
„ 24th, „	1·499	1·38877	— ·00004
„ 24th, „	1·495	1·38874	— ·00007
May 19th, „	—	1·38876	— ·00005
July 30th, „	1·497	1·38880	— ·00001
Aug. 18th, „	1·489	1·38863	— ·00018
„ 21st, „	—	1·38901	+ ·00020
„ 24th, „	—	1·38890	+ ·00009
„ 24th, „	1·493	1·38889	+ ·00008
„ 26th, „	1·491	1·38892	+ ·00011
„ 31st, „	1·489	1·38882	+ ·00001
	Mean 1·4912	1·38881	

Mean Value of Constants.

R	R_1	F1	δ	$\frac{R_1}{R_0}$
257·172	357·163	99 991	1·4912	1·38881

BA$_3$.

Date.	δ	$\frac{R_1}{R_0}$	Difference of $\frac{R}{R_0}$ from mean.
Feb. 9th, 1903	1·511	1·38740	+ ·00010
„ 26th, „	1·511	1·38730	+ ·00000
Aug. 10th, „	1·509	1·38714	— ·00016
„ 18th, „	1·522	1·38732	+ ·00002
„ 24th, „	1·511	1·38724	— ·00008
„ 25th, „	1·515	1·38736	+ ·00006
„ 26th, „	1·510	1·38731	+ ·00001
„ 31st, „	1·510	1·38738	+ ·00008
	Mean 1·5124	1·38730	

Mean Value of Constants.

R_0	R_1	F1	δ	$\frac{R_1}{R_0}$
258·367	358·434	100·067	1·5124	1·38730

BA$_4$.

Date.	δ	$\frac{R_1}{R_0}$	Difference of $\frac{R}{R_0}$ from mean.
Feb 11th, 19 3	1·485	1·38816	— ·00009
„ 23rd, „	1·499	1·38833	+ ·00008
„ 26th, „	1·500	1·38826	+ ·00001
Aug. 10th, „	1·497	1·38835	+ ·00010
„ 18th, „	1·473 ?	—	—
„ 24th, „	1·497	1·38825	+ ·00000
„ 26th, „	1·494	1·38812	— ·00013
„ 31st, „	1·503	1·38826	+ ·00001
	1·4935	1·38825	

Mean Value of Constants.

R_0	R_1	F1	δ	$\frac{R_1}{R_0}$
257·627	357·616	99·989	1·4935	1·38825

BA$_7$.

R_0	R_1	F1	δ	$\frac{R_1}{R_4}$
257·749	357·771	100·022	1·506	1·38806
Thermometer electrically heated to 1,400° for 2 hours.				
270·036	375·213	105·177	1·506	1·38949

APPENDIX IV.

The following table gives the resistance at a temperature of 60° F. (15·55° C.) of a wire of pure annealed copper 1 metre in length, having a mass of 1 gramme, as deduced from the most recent determinations.

In making the reductions, the values for the temperature coefficient and for the density given by the author, have been used.

Table giving Resistance at 60° F. of a Wire of Pure Annealed Copper, such that 1 metre weighs 1 gramme.

Authority.	Source of copper.	Reference.	Value in ohm.
Fitzpatrick ...	Electrolytic	'B.A. Report,' 1890	0·1475
Swan & Rhodin	Swan's copper	'Proc. R.S.,' 1894	0·1493
Do. (2nd sample)	„ „	„ „	0·1486
Fleming*... ...	„ „	*Phil. Mag.*, 1893	0·1487
Lagarde	Grammont electrolytic	'Hospitalier,' 1894	0·1488
		Mean value ...	0·1486

* In reducing Prof. Fleming's result, the density has been taken as 8·91 grammes per c.c.

ALUMINIUM CONDUCTORS FOR ELECTRIC TRANSMISSION LINES.*

By JOHN B. C. KERSHAW, F.I.C.

The facts relating to the behaviour of aluminium and its alloys on exposure, which Prof. E. Wilson and the writer have recently published in papers read before Section G of the British Association, at Southport, lend additional interest to an article by Mr. Alton D. Adams upon "Aluminium Conductors for Electric Transmission Lines," which appears in the September issue of the *Engineering Magazine*.

Mr. Adams opens his article by stating that aluminium is in use for the three longest transmission lines in North America, and in a table near the end of his article he gives the following details of these and other lines of aluminium in operation across the Atlantic.

Locations.	No. of cables.	Miles of each.	Circular mils. of each.	Strands per cable.	Size of strands. B. and S. G. approximate.
Niagara Falls to Buffalo ...	3	20	500,000	—	—
Shawinigan Falls to Montreal	3	85	183,708	7	6
Electra to Mission San Jose ...	3	100	471,034	37	9
Colgate to Oakland	3	144	211,000	7	5-6
Farmington River to Hartford	3	11	336,420	7	3
Lewiston, Me.	3	3·5	144,688	7	8
Ludlow, Mass.	6	4·5	135,247	7	7

According to Mr. Adams, the Electra generating plant is rated at 10,000 KW., the Colgate plant at 11,250 KW., and the Shawinigan plant at 7,500 KW., but he does not state that the lines are yet carrying these maximum loads.

The weight of aluminium in these three transmission lines he estimates at 440,000 lbs., 721,000 lbs., and 225,000 lbs. respectively, and taking the cost of the wire used at 30 cents per lb., he calculates that the total outlay upon these three lines has amounted to $415,000 = £83,000.

Since there are from 10 to 20 large power companies in America now using aluminium for overhead transmission purposes, the total weight of metal already in use as a substitute for copper is probably 6,500,000 lbs., representing a capital outlay of over $1,950,000, or £400,000. Details of these lines will be found in the writer's two papers on "Aluminium as an Electrical Conductor," † and in Vols. VIII., IX., X. and XI. of the "Mineral Industry Annual." under the heading "Aluminium." In view of this widely extended utilisation of the light metal for conducting purposes, the importance of the observations upon the resistance offered by the metal to atmospheric corrosion, started by the writer, and now being continued by Prof. E. Wilson, in London, is emphasised. The following remark from the writer's earlier paper may be aptly quoted here:—

In America, electrical engineers are conducting the inquiry in the usual American fashion; and their installations of aluminium for transmission lines in California and other places are, in reality, large scale experiments, which, if unsuccessful, will cause heavy losses to fall upon those who have been financing these undertakings.

* See *Engineering Magazine*, September, 1903.

† *Journal Institution Electrical Engineers*, 1901. ‡ British Association Reports, 1903.

Mr. Adams, in the article we are discussing, refers only indirectly to this very important subject of resistance to corrosion, but his statement that the overhead aluminium wire used on the Niagara Falls and Buffalo transmission line is covered at the Niagara Falls end, with a braid soaked in asphalt, shows that even in America electrical engineers are recognising that the new metal is not weather-proof in all atmospheres, and under all conditions of exposure.

After giving these details of the extent to which aluminium has displaced copper, Mr. Adams passes to a consideration of the relative conductivities of aluminium and copper when used for electrical purposes, and bases his calculations upon a relative conductivity of 60 per cent. that of copper for the lighter metal.

As regards tensile strength, he states that 33,000 lbs. per sq. in. may be taken as the correct figure for both soft copper and aluminium, but that medium hard-drawn copper wire, of the grade usually employed for transmission lines, has a tensile strength of 45,000 lbs. per sq. in.

That these figures are somewhat too favourable to aluminium is proved by the tests given in a paper by Messrs. Perrine and Baum upon the Blue Lakes (California) Transmission line, in which a permanent load of 14,500—17,000 lbs. per sq. in. is stated to be the maximum advisable with the aluminium wire used for this scheme.*

Mr. Adams also admits that, owing to the permanent set which the new metal takes at loads above 15,000 lbs. per sq. in., it is not advisable under any circumstances to exceed the latter limit. American engineers have, therefore, now recognised a second defect of aluminium when used for overhead conductors, and have corroborated the observations upon this point made by Mr. Gavey, the British Post Office electrician, when conducting trials in Staffordshire, England, in the years 1900 and 1901.

Regarding the high coefficient of expansion possessed by aluminium (the property which caused its failure when used for trolley-wire purposes in Leeds), Mr. Adams states that this is always allowed for in the American transmission lines, and that the lines are erected with a much greater sag between the poles than is customary when copper is employed.

This feature of construction brings one advantage in its train; for the vibration of the line, and the tendency for cross-arms, pins, and insulators to work loose, is much less than when the wires are strung so tightly that vibration occurs in high winds. In strong winds or gales, the aluminium wire strung with a proper amount of sag takes a fixed position at definite angles with the vertical. The change in length, due the higher coefficient of expansion, is stated to be 40 per cent. greater than in the case of copper.

As regards jointing, Mr. Adams states that mechanical sleeve joints are most commonly employed, and he does not recommend soldered or autogenous welded joints. Tie wires should always be of aluminium, otherwise there is risk of cutting or damaging the softer aluminium wire.

It is in order to avoid the risks due to such damage of wires that stranded aluminium cables are now nearly always employed in America for overhead work. The sizes of wires used in constructing these cables vary from No. 6 to No. 9 B. & S. gauge.

Finally, Mr. Adams discusses the question of relative cost, and states that in America aluminium is now cheaper than copper for conducting purposes. For the new Niagara and Buffalo transmission line erected in 1901, the use of aluminium is said to have effected a saving of 12 per cent. As copper was selling at over £70 per ton during 1899, 1900 and 1901, it is quite possible that such a saving could have been obtained by substituting aluminium; but, as shown in the author's recent paper, the present relative costs for equivalent conductivities are—copper 816, aluminium 1,000. Unless the latter metal can be obtained in the form of wire at a much lower price than has yet been quoted for it in Europe, its use for overhead transmission lines is, therefore, unlikely to extend with the rapidity that has been witnessed in America. It would be interesting to know what profit the Pittsburg Reduction Co. has made on the sale of stranded conductors of 99½ per cent. aluminium at 30 cents per lb. (equal to £139 per ton); but this is a point upon which information is unlikely to be forthcoming. According to the published trade prices of aluminium in ingot form, the above profit (to indulge in an Irish bull) would be a negative quantity.

* *Transactions American Institute of Electrical Engineers*, 1900.

THE CENTRAL STATION BATTERY.

By R. W. VICAREY, Mem. Amer. Electro-chemical Society.

It is pleasing to notice that now and again there appears in the columns of the Electrical Review an article bearing upon the much neglected subject of storage batteries.

I say "neglected" advisedly, because even to day, although much enlightened, there appears to be a shroud of mystery surrounding the storage battery, whether it be in the private installation or the more advanced central stations, and I can only suppose this apparent mystery deters a great many from attacking the subject.

As one who has been intimately associated with the manufacture and use of storage batteries, I feel that an answer, and I may say an additional article in support of Mr. Abraham, will not only give him pleasure as showing that his articles are read and appreciated, but may also bring other views and articles, giving valuable and practical information upon the subject.

I must fully endorse Mr. Abraham's statements as to the deplorable condition of a very great number of storage batteries all over the country, and it is only the makers of storage batteries who realise how very much they are dependent upon their clients for the welfare of their batteries, as the very best developments of the latest improvements designed to meet the most severe demands are quickly and easily destroyed if placed in the care of persons who have not sufficient interest to study their welfare, and, unfortunately for the makers, the unanimous verdict of inquiry is usually summed up as "due to a defective battery."

The demands of a central station undoubtedly vary within very wide limits, and it becomes extremely difficult to design and construct a battery to be uniformly durable and efficient inside such limits, quite as much as would be the case when a 250-H.P. engine had to work at, say, 10-H.P. load efficiently, and this fact makes the battery somewhat more delicate than it would possibly be otherwise.

Although one cannot say that a battery needs skilled attention, yet one is quite justified in saying that it needs ordinary and regular attention equally as much as any other part of the plant installed, and were it to get only one-tenth part of such attention there would not be so many batteries ready for the "scrap heap" as Mr. Abraham intimates.

It is certainly a step in the right direction, as Mr. Abraham points out, to be able to record the volts of individual cells in a large battery rapidly, as it is a very essential point to get the readings as quickly as possible, so as to compare individual cells, at as nearly as possible the same time; but I would suggest that the volts of the cells of a battery, even when taken very regularly, do not always form a record by which one can readily detect a sick cell, and a still more reliable method, I find, consists in taking the specific gravity of every cell.

During the past 13 years that I have been associated with the manufacture of storage batteries, I have had the opportunity of testing, by charge and discharge, many hundreds of cells of various types, and I have always found that to analyse the results, condition, or behaviour of the cells it is most important to have careful specific gravity readings as well as E.M.F. readings; personally, I prefer specific gravity readings to E.M.F., if I cannot have both together. It is very possible for a cell to be slowly sulphating and becoming sick, but yet to maintain its E.M.F., more especially at the end of a charge.

Even a partially short-circuited cell will sometimes give its normal E.M.F. while charging. But by taking the specific gravity readings of the cells at a definite time, say, at the moment before charging, or at the end of the charge, or, better, both, and then recording these regularly, a sick cell will be readily detected as it slowly decreases in its state of health.

Temperature, as is now well known, has a very marked

effect upon the capacity of a storage battery by considerably increasing its efficiency and thus producing a very different E.M.F. curve, compared to the E.M.F. curve of the same cell under normal temperature.

Temperature also has its effect upon the specific gravity of the electrolyte, and also produces a different curve (if plotted) to the normal, but the comparative differences are very much less in the case of specific gravity than in the case of the E.M.F. It is also well known that there is a fixed fall in degrees on the hydrometer for every ampere-hour taken out of the cell, and it is therefore possible to ascertain very closely the actual ampere-hours put in or taken out of a cell by its specific gravity, but this cannot be done when taking E.M.F. readings. I grant that it is a very monotonous occupation to go round a large battery and take specific gravity readings, or E.M.F. readings either, and it is something gained if only one is done systematically, but it is undoubtedly more conclusive evidence of sickness when one can confirm a reading from a separate source, and especially when an E.M.F. reading may be in error due to a bad contact.

Another point in favour of specific gravity readings will be found in the fact that one is not limited to time so strictly as when taking E.M.F. readings, providing that the excessive gassing produced by charging has been allowed to dissipate itself. The device of the Walsall Co. is undoubtedly a very great saving in time, and will do much to enable a battery to have more records than previously has been the case.

Unfortunately, there still remains that source of danger in erratic readings due to improper contact with the collecting bars of the cells; and however simple and easy it may appear to the casual onlooker, yet it is a very difficult job to take a great number of readings and secure good contacts, the more especially when generally a film of acid spray is spread all over the collecting bars, and this very soon has a marked effect on delicate readings due to corrosion of the metal pointers.

When a cell is found to be sick or to be lagging behind others, it should be at once examined and the cause removed; if there be nothing apparent to indicate a reason for such lagging, an analysis of the electrolyte will no doubt supply the information required, and in all probability save the cell from being ruined.

I would also suggest that the temperature of the battery room be entered regularly in the log-book, in order to compare results obtained during winter and summer, and also for other purposes, for which it is often valuable.

Much could be written on storage batteries from a practical point of view, and as Mr. Abraham very justly remarks, it is absolutely surprising to see the conditions of various batteries, and it is still more surprising that, considering the little attention they get, so many maintain their output and durability even for the two or three years he has allotted to them. Undoubtedly the initial cost and maintenance, which is very great at present, will be very considerably reduced if simple precautions are taken and inspections of the battery made, equal in time and care to those of the other sections of the complete installations.

Space does not permit of any further remarks, but I should be pleased to see more often, in the columns of this paper, articles from practical men upon storage batteries, which would be both interesting and instructive.

THE MOST ECONOMICAL CONDITIONS IN COPPER REFINING.

In a paper read before the American Electro-chemical Society on September 17th, Mr. Wilder D. Bancroft discussed, under the title of "Electrolytic Copper Refining," the most economical conditions of current density and temperature under which the deposition of the copper should take place.

The whole of the arguments are based upon a series of systematic experiments in which the use of four solutions of copper sulphate is involved, as follows:—

Solution A.—16 per cent. Cu SO_4 5 H_2O and 9 per cent. sulphuric acid.

Solution B.—16 per cent. Cu SO_4 5 H_2O and 6 per cent. sulphuric acid.

Solution C.—Solution A + 1 : 2,000,000 sodium chloride.

Solution D.—Solution B + 1 : 2,000,000 sodium chloride.

A series of experiments was then made with these solutions to determine the variation of voltage with that of temperature and current density. The temperatures chosen were from 20° C. to 90° C. in steps of 10° at a time, and the current density from 1·0 ampere per sq. dcm. to 4·0 amperes in steps of 0·5 amperes, so that 224 voltage readings were made, which show a steady rise as the current density rises and a gradual fall as the temperature increases, showing a minimum of 0·044 volt at 1·0 ampere per sq. dcm. and 90° C.

The next experiments were to determine the variation of current efficiency under similar varying conditions to those of the foregoing experiments, the standard being based upon a carefully constructed copper voltameter. Two sets of figures were here recorded, the cathode deposition efficiency and the ratio of the anode loss to the cathode gain which represented the gain in copper of the solution, or the loss in free acid, or in other words, the deterioration of the solution.

The readings of current efficiency varied almost inappreciably, and were in all cases good, approaching 100 per cent. The deterioration of the solution was more apparent at lower current densities and higher temperatures.

From the foregoing results the author goes on to construct a third set of tables by calculation, showing the watt-hours per gramme of copper deposited under variations of current density and temperature and from the four different solutions.

One of the most important items in electrolytic copper refining is the cost of maintaining the electrolytes in the vats at operating temperature, and the author next describes the results of a series of experiments instituted to determine the loss of heat by radiation from a vat of commercial dimentions when kept at the different temperatures above described, and calculates the amount of power to which this loss corresponds. Readings were taken both with and without the tank covered, the cover being found to obviate a very considerable loss of heat.

Having thus obtained all the data from which to calculate the economical efficiency of copper refining under varying conditions, the author proceeds to construct a table of costs which is here given :—

Table XII.—Cost of Refining Tank of Copper.

Amps. per sq. dcm.	Temp.	KW.-hours to deposit.	Cost to deposit.	KW.-hours to heat.	Cost to heat.	Interest on copper.	Total cost.
1·0	20°	390	$1·195	000	$0 00	$2·975	$4·17
1·0	50°	190	0·601	793	2 425	2 975	5 40
1·0	70°	153	0·468	1,550	4·755	2·975	7·73
1·0	90°	134	0·411	2,360	7·205	2 975	10·18
2·0	20°	608	1·86	000	0·00	1·487	3·35
2 0	50°	362	1·11	396	1·21	1·487	2·70
2·0	70°	274	0·84	775	2·38	1·487	3·87
2 0	90°	233	0·71	1,180	3·60	1·487	5 09
3 0	20°	795	2·43	000	0·00	0 99	3·42
3·0	50°	519	1·59	264	0 81	0·99	2 58
3·0	70°	400	1·22	517	1·58	0·99	2·57
3·0	90°	341	1·04	787	2·40	0·99	3·39
4·0	20°	1,000	3·06	000	0 00	0 74	3·80
4·0	50°	647	1·98	198	0 61	0·74	2·72
4·0	70°	519	1·59	388	1·19	0·74	2·33
4·0	90°	433	1·33	590	1·80	0·74	2·54

The costs have been retained in their original form of dollars, as they are only relative, and would not represent truly the exact cost under the same conditions in England. The cost of heating, or maintaining the vat at the proper temperature, is calculated on the basis of electrical energy at $20 per horse-power-year.

The author sums up the results thus obtained, and draws conclusions as to what are the most financially economical conditions under which to refine copper electrolytically. He points out that the most satisfactory results are obtained at a temperature of 70°. Between 3·5 and 3 75 amperes per sq. dcm. the cost at this temperature falls to a minimum, and would be most advantageous, as at this current density, and with the tanks covered, no extra power would be required to heat the solution, as the current would

alone be sufficient to heat the electrolyte to 80°, and would allow for radiation and a working temperature of 70°. An additional advantage in this current density (3·5 amperes per sq. dcm., or 31·5 amperes per sq. ft.) would be the reduced size of the tanks for the precipitation of a given amount of copper in a given time, being a considerably higher current density than that used in European practice of about 14 amperes per sq. ft., at a temperature of 50°.

The author finally recommends, as the results of his researches, the following conditions :—(1) Covered tanks; (2) Current density, 3·5 amperes per sq. dcm. (31·5 amperes per sq. ft.); (3) Temperature, 70° C., taking energy at $20 per horse-power-year.

The effect of the sodium chloride in solutions C and D seemed to be so small as to be almost negligible. The introduction of from 1 to 6 per cent. of ferrous sulphate into the copper bath, contrary to what is generally stated, did not interfere in the least with the current efficiency of the copper deposit nor with its purity; the deterioration of the solution was, moreover, but little affected. These latter experiments were conducted with a current density of 2·0 amperes per sq. dcm., and a temperature of 45° C.

KILROY'S STOKING INDICATOR.

Where one fireman has a number of furnaces to fire, he can usually do so without difficulty, for he soon learns to judge the time for firing, and he takes his furnaces in regular rotation. In the stokeholds of a large steamer with a large number of boilers, and many firemen and furnaces, the balance of work is difficult to secure between the different boilers, and even between the furnaces in one stokehold with many firemen, often under difficult conditions.

As an aid to better and more regular stoking, and to a balance of labour in the different stokeholds, a stoking indicator has been devised by Mr. W. D. Kilroy, and is made by Messrs. Evershed & Vignoles, Ltd., of Acton Lane, Chiswick. In this apparatus an indicator of considerable size is placed in each hold, and provided with a loud gong. All the indicators are connected to one central mechanism. The stokehold indicator carries on its face the words "fire furnace No.—," and there is an opening in which appears the number of the furnace that is to be fired, this figure being changed at regular intervals concurrently with a stroke on the gong.

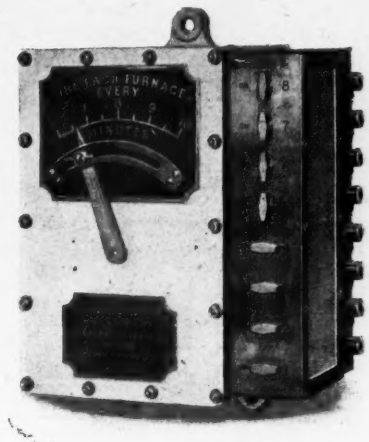


Fig. 1.—Regulator.

Fig. 2.—Indicator.

As each stroke sounds, and a fresh number appears, the stoker proceeds to fire the corresponding furnace. It is desirable that each furnace should be plainly numbered in permanent brass figures. The regulator or timing apparatus is conveniently placed in the engine room, or otherwise convenient to the engineer in charge, who should also have before him a steam gauge in order that he may adjust the regulator to give suitable intervals.

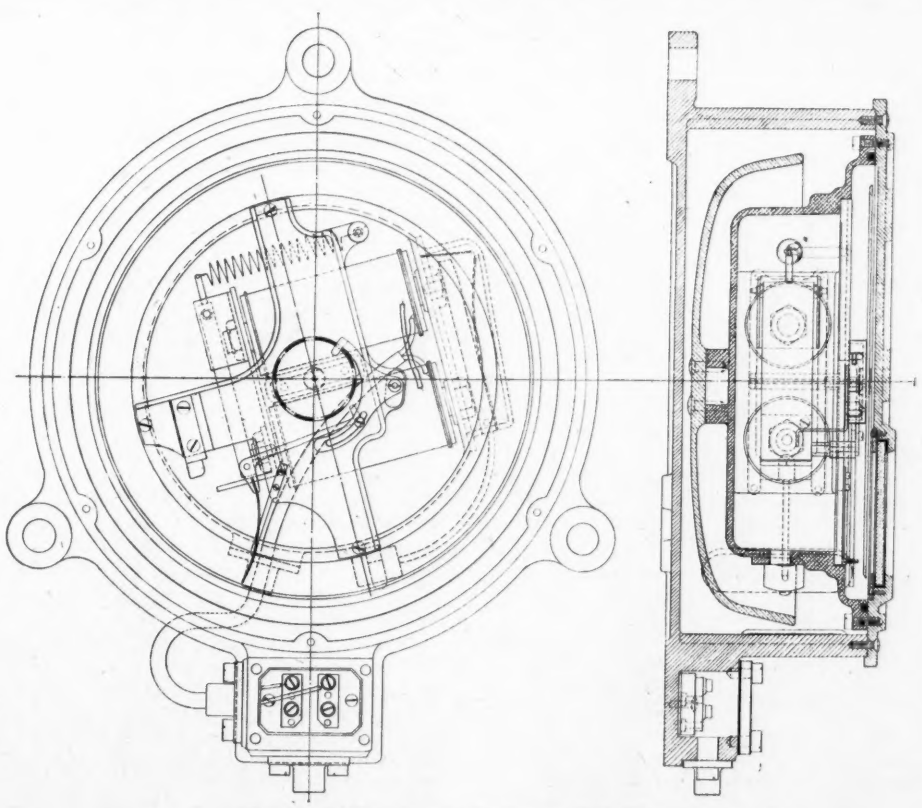


Fig. 3.—Elevation and Section of Indicator.

The indicator is shown in fig. 2 as it appears, and in fig. 3 its general arrangement is shown. A stout case encloses the gong and the movement, which includes an electro-magnet. Current being passed round this, one armature is attracted, and strikes the gong, while the other causes the number dial to move one figure forward.

The two magnets are wound in series, so that the pull of one and the braking action of the other may maintain a constant ratio under possible variation of pressure of the actuating current. They are, in fact, self-regulating. There are two driving magnets symmetrically placed as regards the soft iron armature, but only one is energised at any one time.

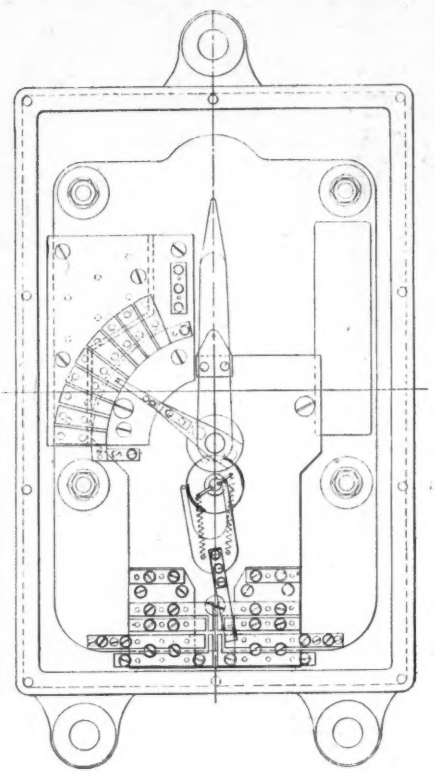


Fig. 4.

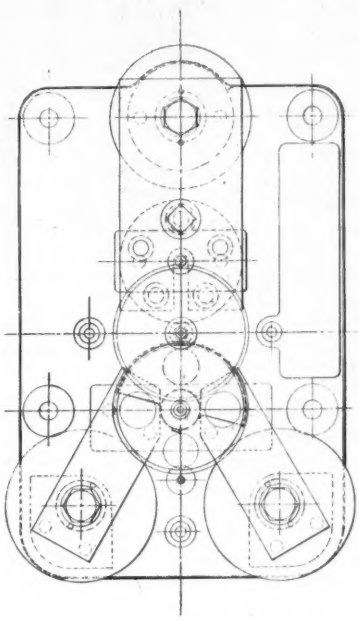


Fig. 5.

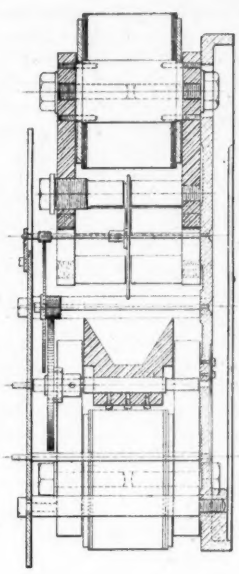
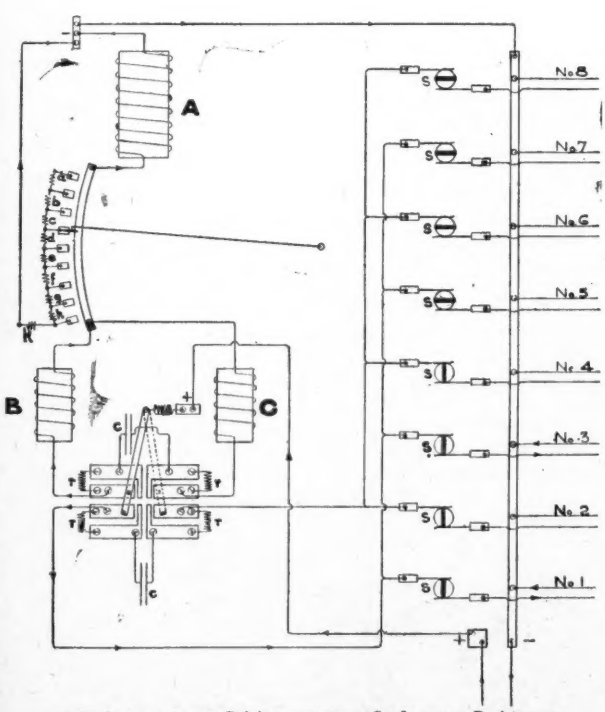


Fig. 6.



A, Brake magnet; B, C, Driving magnets; *c*, Condenser; *r*, Resistances to reduce sparking; *s*, Switches, *a* to *h*, Stepped resistance.

Fig. 7.

The regulator, shown externally in fig. 1, and internally in figs. 4, 5 and 6, is also electro-magnetic in action. The driving force is exerted by one of two magnets upon a soft iron armature which, in swinging under such action, actuates a train of wheels driving a plain copper disc which rotates in the magnetic field of a second magnet, and is impeded by the Foucault currents induced thereby.

An automatic switch serves to change over from one to the other as the armature moves to the limits of its swing. The swing of the armature and of the copper disc continues so long as current is flowing through the apparatus, and the same automatic switch makes and breaks the connections of the stokehold indicators, which sound the gongs and shift forward the figures. The break is made gradually with a condenser joined across the gap to check sparking. The brake disc revolves in a field which can be varied at will by means of a sub-divided shunt resistance, wound with nickel wire to compensate by its high temperature coefficient of resistance for the temperature coefficient of the copper disc, and thus synchronising for changes of temperature.

By varying the field the speed of the copper disc is varied so that the indicator may move at shorter or longer time intervals.

The electric drive is considered simpler than ordinary clock mechanism, having few parts and requiring no winding up, and as it is variable over a wide range large forces are available, thereby enabling adequate switches to be employed automatically; at the same time only 0·6 ampere on an 80-volt circuit is consumed by the apparatus, of which 0·2 ampere is used in the regulator and 0·4 ampere on eight indicators.

It is not to be expected that every furnace in a set of boilers will burn at the same rate, and even though fired regularly at even intervals, some fires may burn away more quickly than others. The idiosyncrasies of individual fires will, however, soon be learned, and firemen will accommodate their firing to those so as to produce comparatively uniform results.

These are minor troubles. Without some guide to regular firing, some of the fires will be omitted in their turn and others will become too thick.

Where a large number of boilers are in several different stokeholds, and all are supplying steam to one engine department, it is necessary that each stokehold should be synchronised with the remainder. This done, and the rate of firing regulated for the lot, the work in each hold will be

fairly equalised. Though primarily designed for use in the Navy, there is no reason why the Kilroy apparatus should not be useful in stationary work also, when mechanical stokers are not employed.

In fig. 7 the electrical connections of the apparatus are shown, the circuit switches for four stokeholds being shown closed and the other four open.

The apparatus has been fitted to H.M.S. *Hogue*, *Sutlej*, *Implacable* and *Bacchante*, and the results have proved so satisfactory that orders have been placed for the fitting of 10 additional vessels, seven of which are first-class battleships and the remainder first-class cruisers.

WOLVERHAMPTON'S FOLLY.

With feelings of relieved regret we learn that Wolverhampton has committed itself utterly to the surface contact system; relieved, because we have long been a-weary of the eternal wranglings, and somersaults, and general gymnastic displays, of the Council; regret, in that we are confident the Council has been ill led, and has put a rod in pickle for their electors.

The Council has published a comparative statement, showing estimated capital and annual costs of the overhead and Lorain systems as applied to the new routes. Taking the figures as they stand, we find that on the five miles of route now to be constructed, the Lorain system involves extra capital outlay on permanent way, electrical equipment, feeder cables, and cars, to the extent of £7,900 for double track wherever possible, and £5,800 for single track with passing places.

This is equivalent to £1,580 per route mile extra for double track, and £1,130 per mile for single track.

In these times, when every Corporation is feeling acutely that it can get money no more readily than private individuals or companies, we might be pardoned for thinking that the reduction of the capital outlay on any scheme would be sounder finance than the undue inflation of it. Watering it really is, for it cannot be rightly urged that the revenue will be increased by any fruition of the added capital. Whether the system is overhead or surface contact, the same number of revenue-earning cars would be run, and equal revenues would be earned, as there is no greater attraction to the travelling public in a car on one system than in a car on the other, and, obviously, less return will be made on the capital of the more costly system.

We know already that the cost of running on the overhead system is admitted to be less than on the contact system, and we gather from the comparative statement that the extra is estimated at ·55d. per car-mile on double track, and ·48d. per car-mile on single track. Far from the extra capital rendering the undertaking more productive than it would be with the overhead system, it actually lessens the productive power by increasing the working expenses, and that not by an insignificant thousandth of a penny, but by an amount per car-mile that is usually considered sufficient to cover the whole maintenance of the cars.

Although the fact is not stated in a way to make its significance sufficiently clear to the lay mind, explanatory notes at the beginning point out that the figures of annual expenditure estimated for the overhead system on two routes are inclusive of the extra current consumption, maintenance and renewals of the skates, magnets, batteries, &c., which would be fitted to enable the cars to get to and from the existing depôt. This still further increases the difference between the running costs of the two systems.

Have the people of Wolverhampton realised at any time during the controversy that, even when taking the figures most favourable to the contact system, they are deliberately fining themselves heavily, solely in order that a town which, for the most part, cannot be termed picturesque, may be spared the harrowing sight of poles and wires, such as have been accepted readily by some of the most beautiful cities in Europe?

As we have shown at some length in previous issues, the awakening of the ratepayers will be even more bitter than is foreshadowed by the official statement of comparative costs, for it is not likely that the maintenance costs given in all the official estimates have been unfavourable to the contact system.

A pamphlet by Mr. Ernest White, addressed to the constituents of his ward in Wolverhampton, arrives opportunely to indicate concisely the history of a struggle in which he has been found, together with a few other level heads, consistently on the side of economy, inter-communication and speedy settlement. Mr. White is one of those members of the Tramway Committee who lately resigned their positions, as a protest against the folly, of the majority.

Let us take a glance at Mr. White's pamphlet. In February, 1900, the old company was bought out under the Act; but it was not until October that the Council decided *unanimously* to adopt the overhead system for the whole undertaking. Seven months after it had been decided to reconstruct two routes *immediately* (May, 1901), and 21 months after obtaining powers, there was no sign of electric traction in the town. Alderman Mander then advocated the Lorain system, and had little difficulty in arranging to have 11 miles of it laid under an agreement, which in the sequel has proved of little value to the town. At the end of the period of trial a report, with which we dealt at the time, was prepared by the electrical engineer, and formed subject matter for a three days' debate. The chairman of the committee here moved that although the Lorain Co. had not complied with the terms of the agreement, the system should be taken over subject to certain renewals. To this Mr. White moved an amendment that the system be thrown back on to the contractors. This, in fact, meant arbitration, and a majority of the Council accepted it. One month later this resolution was practically rescinded by a larger majority voting that fresh negotiations should be opened with the Lorain Co. by means of a sub-committee which was constituted entirely of men whose minds were fixed on the retention of the contact system. The suggestions of this sub-committee were refused by the Council until they had been debated in secret. Mr. White says:—"At this meeting there was no printed or written report in the hands of the members of the Council, not even a written notice of the chairman's resolution, and figures were quoted which members had no opportunity of verifying. . . ."

Nevertheless, nobody could have been greatly surprised, after so many instances of the collective wisdom of the Council, to hear that the most unstable majority on record had accepted the system at the company's price.

It only remained, after three years' experimenting and palavering, to decide on the nature of the equipment of the remaining routes scheduled, and the Council have capped their folly by their last triumphant decision to instal the surface contact throughout.

It is useless to conceal the fact—several of the councillors troubled not to conceal it in full Council—that the real reason for the success of the Lorain Co. lies not in any sincere belief in the commercial success of their system, except perhaps in the minds of a few of the lower councillors who would readily believe that the moon is made of green cheese if such a statement were made by a stronger mind and supported by "figures," but in a nothing less than fanatical desire to be freed for ever from the attempts of the electric traction undertakings skirting the borough to make real physical and through connection between the populous country about the centre and the centre itself.

The facts that the rates are touching 10s. in the £, and that increases are foreshadowed, that the extra cost of the Lorain system on the most favourable estimate is to be over £5,000 per annum, that certain other recent "reproductive" enterprises are turning out badly, all went for nothing when the majority ran amok. At this time of day, when free intercommunication is just as indispensable to the continued vitality of any district as the free circulation of blood is to the life of every part of the body, it would have seemed strange in any other but a Wolverhampton paper to read the professedly solemn opinion of several "representatives" of the people that too much was being made of the 'bus rides, of the horse-car rides, or of the change of cars which greet the traveller who leaves a trolley car outside the boundary with the idea of getting to the heart of the town; that, in fact, "intercommunication" was a bogey cry raised by wicked anti-municipalisers. It is very evident, of course, to any level-headed person—in which category are to be included the consistent members of the minority on the

Council—that intercommunication involving through running of a company's cars on a corporation's track is by no means incompatible with municipal ownership, but is most certainly the soundest policy under the conditions existing in and about Wolverhampton, and might be turned to the direct financial benefit of the town.

The comparative statement mentioned above contains an estimate of the annual mileage on the new routes to be built. Is there any objection to our multiplying that total by 10d. to ascertain what will be the gross receipts? (10d. per car-mile used to be below the consideration of the chairman of the Tramways Committee.) Is there, further, anyone to say that the whole of this paltry 5 miles of route might not have been equipped and running on the overhead system by the end of 1901, at the outside, if the matter had been in capable hands? From that time to now, and from now to the time when the construction should be completed if started immediately, gross receipts to the amount of £30,000 might have been earned. How much of this sum could be credited to net revenue we will leave to the accomplished statisticians on the more powerful side of the Council; perhaps rather more than the net revenue earned by the horse vehicles that have been granted an unwarranted new lease of life in death.

The attitude of the Council towards the question of intercommunication is instructive in its simplicity. The Council views the subject as one having no connection with its own electors, but as a matter of so much gain or loss to the outside company solely. It says quite distinctly :—"We have adopted the Lorain system, and we are contented to roll our cars about inside our unnatural confines. You are mighty anxious to increase your receipts by offering the public rides on through cars, so, if you will equip your cars with an apparatus that costs a lot of money to put on, and keeps on costing more money to maintain, we may consider your running over our tracks—at a price."

Wolverhampton offers one of the worst instances of unreasoning and self-destroying company-hatred that is to be found at the present time.

NEW PATENTS APPLIED FOR, 1903

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

21,318. "Improvements in or relating to electric switch-holders or key switches." C. H. Davies. October 5th.

21,320. "Improvements in apparatus for electric signalling." C. F. Brodin and H. A. Schepeler. October 5th.

21,338. "Improvements in or relating to typewriting telegraphs and to typewriting apparatus." S. de Stefani. October 5th.

21,344. "Improvements in and connected with storage batteries." E. J. Wade. October 5th.

21,359. "Improvements in arc lamps for dark lanterns, cinematographs and similar apparatus." N. Kohler. October 5th.

21,363. "Improvements in electric accumulators." J. E. G. Meran. October 5th.

21,386. "Improvements in or connected with electric fuses or cut-outs." J. H. Mercadier. October 5th.

21,404. "Electricity meter for alternating currents." Siemens Bros. & Co., Ltd. (Siemens & Halske, Actien-Gesellschaft, Germany.) October 5th. (Complete.)

21,405. "Improvements in electricity meters for motors." Siemens Bros. and Co., Ltd. (Siemens & Halske Actien-Gesellschaft, Germany.) October 5th. (Complete.)

21,466. "Improvements relating to electric arc lamps." F. Jeannot and F. de Zea Bermudez. (Date applied for under Patents Act, 1901, September 12th, 1903, being date of application in France.) October 6th. (Complete.)

21,493. "Apparatus for perforating the type bands for automatic telegraph transmitting apparatus and the like." Siemens Bros. & Co., Ltd. (Siemens and Halske Aktien-Gesellschaft, Germany.) October 6th. (Complete.)

21,504. "Improvements in electric meters." Societe Anonyme des Ateliers de Mecanique de Precision de Territet. (Date applied for under Patents Act, 1901, October 15th, 1902, being date of application in Switzerland.) October 6th. (Complete.)

21,511. "Improved means of temporary holding electric light lamps by magnet." L. B. Mollan and A. Millin. October 7th.

21,551. "Improvements in switches for use for electric lighting and power." K. Quaney and W. C. Kirwan. October 7th.

21,574. "Improvements in apparatus for disinfecting telephones." N. J. Tubbs, R. H. Smith, and I. S. Hartley. October 7th. (Complete.)

21,582. "Improvements in primary electric batteries." G. Schauli. October 7th.

21,592. "Improved electro-magnetic signalling apparatus." Siemens Bros. and Co., Ltd. (Siemens & Halske, Aktien-Gesellschaft, Germany.) October 7th. (Complete.)

21,596. "An improved rheostat." F. M. Short. October 7th.

21,598. "Improvements in self-replacement intercommunication telephones." F. Petmeky. October 8th.

21,609. "Electro-deposition of metals upon aluminium." J. Creswick and H. Shaw. October 8th.

21,628. "Improvements in accident-preventing or life-saving apparatus for electric tramcars and like vehicles." W. H. Taylor. October 8th.

21,632. "Improvements for electric igniting devices for petards." F. Hulsmann. October 8th.

21,637. "Improved electrical alarm-clock." H. Peters. October 8th. (Complete.)

21,652. "An improved form of electric accumulator or secondary battery." J. M. de la Croix. October 8th.

21,653. "Improvements in coherers for wireless signalling." T. E. Clark and the Thos. E. Clark Wireless Telegraph-Telephone Co. October 8th. (Complete.)

21,700. "Improvements in electrical measuring instruments." C. Beez. October 8th. (Complete.)

21,717. "Improvements in apparatus to be used in connection with trolley lines for electric traction." J. I. Hall. October 9th.

21,759. "Improvements in telephones, metallic circuit automatic secret intercommunication instruments." E. G. Bradnam. October 9th.

21,779. "Improvements in and relating to electric cells." T. Heffernan. October 9th.

21,791. "Improvements in the manufacture of filaments for incandescing electric lamps." J. R. Crawford. October 9th.

21,830. "Improvements in or relating to electric ignition apparatus for internal combustion motors and the like." E. W. Lewis. October 10th.

21,846. "Improvements in trolleys for electric tramways." J. N. Dauncey. October 10th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1902.

22,023. "Improvements in insulators used for electrically dividing into sections trolley wires as used on electric railways." H. Brecknell, E. M. Munro, and H. I. Rogers. Dated October 10th.

22,184. "Improvements in electrical signalling and controlling apparatus, chiefly designed for artillery purposes." Lewes & Kirke. (Secret Document under Sec. 44, Patents, &c., Act, 1883.) Dated October 11th. (Complete.)

22,233. "Improved electric heating apparatus." F. de Mare. Dated October 13th.

22,249. "An improved method of apparatus for the production of high frequency electric currents." R. Scharf. Dated October 13th.

22,421A. "Improvements in electro-magnetic releasing mechanism for electric switches or cut-outs." C. M. Dorman and R. A. Smith. Dated October 15th.

22,551. "Improved electrical signalling system for railways." C. W. Mills and W. W. Piddington. Dated October 16th.

22,783. "Improvements in electrical switches." H. W. Cox. Dated October 20th.

23,323. "Improvements in sparking plugs for use in connection with the electric ignition systems of internal combustion engines." J. S. Foley. Dated October 27th.

23,461. "Improvements in magnetic apparatus for the distribution of current to electric tramways and railways by road contact." B. J. B. Mills. (A. Diatto.) Dated October 27th.

23,606. "Improvements in electric arc lamps." P. Hogner. Dated October 29th.

24,031. "Improvements in overhead guards for electric cars." T. T. Hindle. Dated November 4th.

24,033. "Improvements in and relating to oiling vertical electric motors which are worked intermittently, as in the case of driving centrifugal machines direct by an electric motor." J. W. MacFarlane. Dated November 4th.

24,128. "Improvements in electric motors, the invention being applicable to electric fans." A. B. Holson. Dated November 4th.

25,175. "Improvements in and relating to pendant, electrolier, and bracket electric switch connections." J. F. Smith. Dated November 17th.

26,071. "Improvements in the manufacture of arc lamp electrodes." R. Hopfelt. Dated November 26th.

26,388. "Improvements relating to dynamo-electric machines." S. Sacerdote. Dated November 29th.

26,967. "Improvements in automatic pressure regulators for electric collectors." C. de Kando. Dated June 18th.

27,090. "Improvements in apparatus for working railway points and signals by electric power." F. W. Webb and A. M. Thompson. Dated December 9th.

27,657. "Improvements in and relating to arc lamps." T. L. Carbone. Dated December 15th.

27,933. "Pneumatic device for automatically actuating the starting rheostats of electro-motors driving organ-blowing apparatus and for reducing the starting load of such motors." R. A. Cousans and L. B. Cousans. Dated December 18th.

28,092. "Improvements in and relating to arc lamps." T. L. Carbone. Dated December 19th.

28,353. "Improvements in electrolysing processes and appliances." J. Wetter. (Elektricitäts Aktiengesellschaft vorm Schuckert & Co.) Dated December 23rd.

28,599. "Improvements in electro-magnets and armatures actuated thereby for translating electric current into motion." A. Favarger. Dated December 24th.

28,792. "Improvements in electric heaters and rheostats." M. C. Krueger. Dated December 30th

1903.

7,107. "Improvements in electric drilling machines." R. Brebach. Dated March 27th.

7,184. "Improvements in and relating to switching devices for inter-communication telephones." E. L. Joseph and G. Gardner. Dated March 27th.

7,590. "Improvements in or connected with means for electrically igniting miners' safety lamps." B. D. Williams. Dated April 1st.

7,697. "Improvements in incandescent electric lamps." R. Drecker. Dated April 2nd.

7,700. "Improvements in electric fire alarms." J. W. Uytenbogaart. Dated April 2nd.

7,718. "Improvements relating to electric switching arrangements." W. E. Evans. (Allgemeine Elektricitäts Gesellschaft, Germany.) Dated April 2nd.

7,980. "Improvements in self-registering electrically operated sectional targets." G. A. Peters. Dated April 6th.

8,010. "Improvements in and relating to an electric push contact device." W. G. Heys. (The Richmond Electric Co., U.S.A.) Dated April 7th.

8,021. "Improvements in induction motors." A. L. Cushman. Dated April 7th.

8,056. "Improvements in or relating to incandescent electric lamps." A. J. Boult. (The American Miniature and Decorative Lamp Co., U.S.A.) Dated April 7th.